Spraying Machinery

Pesticide Chemicals

THE UNIVERSITY OF MICHIGAN
JUN 28 1961

WORLD CROPS

The International Journal of Agriculture

VOLUME 13, No. 6 JUNE 1961

SEVIN Brand Insecticide dust being applied to cotton for the control of destructive insects. The applicator does not have to wear a mask or protective clothing. *For further details, see page* 208

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Published by:
The Leonard Hill Technical Group,
Leonard Hill House, Eden Street, London, N.W.1 (Tel.: Euston 5911; Cables: Lenardil, London).

U.S.A.:
92 Lorraine Avenue, Upper Montclair, New Jersey (Plaza 5-1127, Pilgrim 4-2484); 532 West Harrison Street, Oak Park, Illinois (COLumbus 1-7906); 1501 Euclid Avenue, Room 426, Cleveland 15, Ohio (TOwer 1-2280); 2513 Beverly Boulevard, Los Angeles 57 (DUnkirk 1-2241); 681 Market Street, San Francisco 5 (EXbrook 2-2612); 5210 Morningside Drive, Houston 5, Texas (Jackson 4-6633); Chamber of Commerce Building, Room 1008, Miami 32, Florida (Franklin 1-2103).

ITALY:
Via Filippo Turati 3, Palazzo Giardino, Milan (639367).

SWEDEN:
Tunnelgate 19b, Stockholm.

Subscription Rates:
1 year, £2; 3 years, £5

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WORLD CROPS

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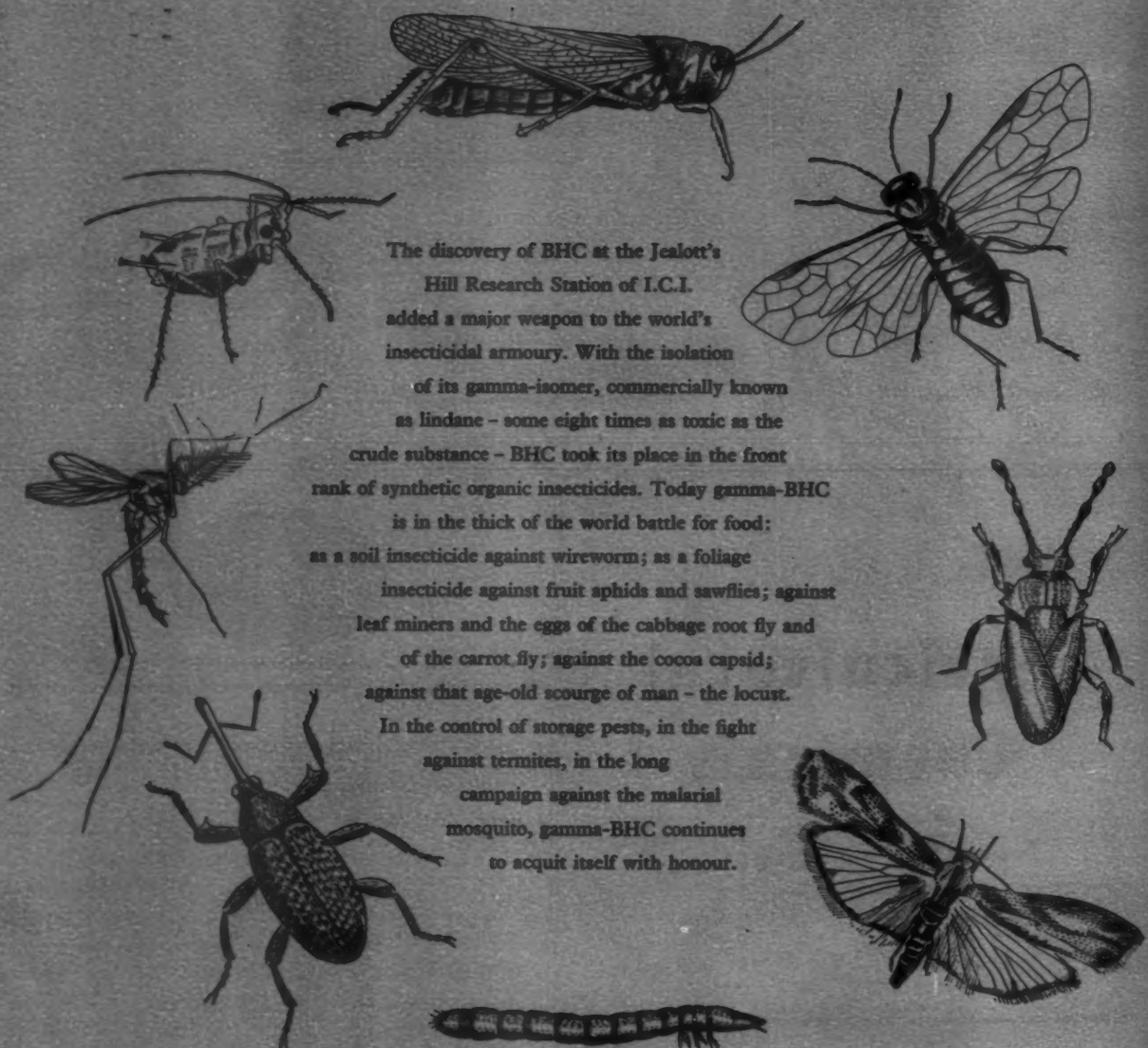
BETTER HARVESTS ROUND THE WORLD

BHC: England: 1943



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Editorial Comment

Pesticides and the Public

CIVILISATION IS MEASURABLE by the degree of control of his environment by man, yet it is not unknown for some people to see in every innovation or invention the certain causes of their ills and misfortunes. It is not surprising, therefore, that the growing use during the past decade of synthetic pesticides should have raised loud protests:

'Are not these chemicals used because they kill insects, weeds, fungi and undesirable soil organisms? Therefore, will they not also contaminate and poison our food crops?'

The plain answer to the first question is 'Yes'. The second question was dealt with by Dr. Hubert Martin in a paper entitled 'Pesticides and the Public', which he presented to the Pesticides Group of the Society of Chemical Industry earlier in the year.

There were, he said, valid reasons for the second question and an answer was necessary to dispel the fears both of those who use the pesticide and those who consume the treated crop. The public must be assured that a poisonous insecticide can be used without hazard to the consumer and to his ultimate benefit. As Dr. Holmes points out in this issue, the collection of properly authenticated data is not easy; on the other hand, the publication of sensational conjecture is so very easy.

One persistent argument is that pesticides are 'unnatural' and therefore evil. This is part of the age-old contention that the diseases and pests which afflict plants are the consequence of man's interference with a so-called 'natural balance'. If so, the restoration of natural conditions can be achieved only by the abandoment of all farming and gardening as an interference with nature.

More realistic is the view that the pesticide, in disposing of pests, also does harm to beneficial insects and wild life. The application of a chemical highly toxic to bees must be avoided on a crop in blossom; the thoughtless disposal of containers in a convenient stream must be avoided as being harmful to fish; and seed which has been treated with, say, dieldrin can be highly toxic to game birds unless the seed is effectively covered with soil.

Safety First

Many studies have been carried out of the hazards involved in the field application of pesticides—to those who handle the formulation, who apply it to the crop, and who work in, or harvest, the crop. It is of the utmost importance that personnel so engaged should implicitly obey all the manufacturers' instructions for their handling and use. These instructions are based often on years of research and on field trials and *the printed words on the labels must be treated as orders.*

Most of the chemicals now used are relatively harmless, but even so it will pay the farmer handsomely always to follow the directions for use and not vary the dilutions or increase the rate of application to, say, double that recommended in order to 'make doubly sure'. A useful pamphlet on the subject, entitled 'The Safe Use of Poisonous Chemicals on the Farm', Leaflet APS/1, has been issued jointly by the Ministry of Agriculture, Fisheries and Food, London, S.W.1, and the Department of Agriculture for Scotland, Edinburgh, 1.

Safety Last

UNDER THE HEADING of 'A Threat to Human Life' in *The Farmer's Weekly of South Africa* for 15 February, 1961, appears a warning to all those who are beginning to use parathion and organo-phosphorus insecticides in the warmer parts of Africa. It is recorded that no fewer than 200 cases of parathion poisoning were treated at just one hospital during the year. Seven children died recently from insecticide poisoning on farms in the Western Province and if a child plays with an empty container and then eats food without washing his hands he is likely to die.

Parathion, of course, is well known in England, where it has been used extensively, although in the beginning the Government had to lay down strict compulsory directions in regard to the wearing of protective clothing when the operators were using the poison. It has always been considered that such pesticides are more dangerous during the warmer part of the year, so it can be understood that in the tropics the danger could be greater.

During the last two years parathion has become one of the sprays used against coffee pests in Kenya and doubtless for pests in other crops. Others of the organo-phosphorus group are also being used and advised by the authorities. Yet there appears to be nothing laid down by the Government in regard to the wearing of protective clothing by labour employed for applying these sprays.

If it has been thought necessary to take such strict precautions in England, where most people are educated, how much more necessary does it seem to impress upon all growers in the tropics the vital need to protect their people when spraying? People should know the precautions and the antidotal measures.

The manufacturers cannot carry all the responsibility, for there are illiterate African workers very

eager to beg or steal containers for use as cooking and drinking utensils and are quite unaware of the dangers involved. It should be necessary either to prohibit the use of the more poisonous sprays or to see that the public are compelled to take all precautions.

There is really no reason why parathion should continue to be used in these countries, as there are now available much safer chemicals which are just as efficient. As regards the containers, the salient point is that they should be washed out when empty and then punctured to ensure that they cannot be used for any other purpose.

Banned from Malaya

SODIUM ARSENITE, at present widely used in Malaya to kill weeds and lallang, will shortly be banned in the Federation. As a result of continued complaints that arsenic poisoning was causing the death of cattle a special committee was formed to investigate the matter. This committee, of which the Minister of Agriculture reported that about $200,000 worth of livestock, equivalent to 150,000 lb. of meat, is lost annually due to arsenic poisoning. Most of the cattle are to be found in the rural areas, particularly in the smallholdings and estates. Since it is now Government policy to increase the country's livestock, adequate protection must be given to the cattle owners, who are mostly peasants.

Arsenic poisoning usually occurs in areas surrounding estates where sodium arsenite is used to kill weeds and lallang. Despite the present legal safeguards, the incidence of cattle deaths from arsenic poisoning continued to cause tremendous loss and suffering to the cattle owners. The regulations governing its use proved ineffective. A number of suitable substitutes were found for sodium arsenite at reasonable prices.

The ban will take effect from August 1961 in order to give ample time to estate owners to utilise their present stock of sodium arsenite.

Government Approval

THE AGRICULTURAL CHEMICALS APPROVAL SCHEME for Britain, under which proprietary brands of crop protection chemicals can be officially approved, is designed to enable users to select, and advisers to recommend, efficient and appropriate pesticides and to discourage the use of unsatisfactory products.

The scheme does not deal directly with the safety requirements for crop protection chemicals, but approval cannot be given for a product containing a toxic chemical unless its safety in use has been properly considered and the necessary precautions for its use have been laid down.

The first list of approved products under this scheme was announced by Mr. Vane, Joint Parliamentary Secretary of the Ministry of Agriculture. The list contains the names of 400 products approved since the scheme was started last June.

Mr. Harold Mellor, chairman of the Association of British Manufacturers of Agricultural Chemicals, said that, compared with a former scheme, the new one was born with teeth. He hoped that in time farmers and growers would buy only those products that carried the new mark of approval.

Crop Chemicals and the Car

IT IS NOW POSSIBLE to discern a pattern in the scheme for the protection of the British public from the misuse of agricultural chemicals similar to that used for the protection of the public from an earlier invention—the motor car. This amusing parallel was used by Dr. Martin to illustrate the co-operation between the agricultural chemical manufacturers on the one hand and the Government on the other in the introduction of the new Agricultural Chemicals Approval Scheme.

Parallel with the adoption of speed limits is the definition of tolerances—the greatest degree of contamination permissible without loss of wholesomeness in the harvested crop. A speed limit requires the use of a speedometer; this corresponds to the agreed analytical methods to be used. The traffic signs correspond to the directions for use, the correct timing of the applications to avoid harmful residues, and the avoidance of injury to bees, birds and other forms of wild life.

Finally, there is the licence to drive a car—or to use a dangerous pesticide. This should require a recording of the details of purchase (as for any other poison) and of occasions of use. This would serve to safeguard the farmer should his produce show an excessive amount of residual pesticide or his men suffer any mishap.

The significant difference between the pesticide and the automobile, concluded Dr. Martin, is that the hazards and risks of the former are lessening as research uncovers new compounds which are effective in pest control yet harmless to man and his animals. The hazard of automobiles is increasing with their numbers and speed of travel.

Progress Brings New Problems

IN A REPORT from the National Agricultural Chemicals Association of America the interesting point is made that the opening of the St. Lawrence seaway, leading ships with foreign cargoes right into the heart of North America, offers an additional 1,400 miles of coastline to possible invasions by pests new to the U.S.A.

The latest report from the Association indicates that pesticide sales in the U.S.A. were 3% higher than in 1959 and were worth some $285 million in terms of wholesale prices.

The survey indicates that almost all American

farmers approve of the use of agricultural chemicals, but that most of them fail to make the maximum use of them either because of lack of equipment or insufficient technical knowledge. Obviously, therefore, there is room for further expansion.

Pending unforeseen developments, it is anticipated that pesticides sales will continue to grow in 1961 because of the growing population and the consequent need for increased and more efficient production of food and other agricultural commodities.

Our Weed Population

WHAT ARE THE MOST PREVALENT WEEDS in Britain? This question has been posed by a leading firm of chemical manufacturers who are inviting farmers in all parts of the country to co-operate in a national survey which is taking the form of a competition.

Entrants are being asked to identify from their silhouettes certain of the commonest weeds of arable crops and then to list weeds which are the most troublesome on their farms.

The information thus obtained, when mapped, should provide valuable information on the relationships between soils, weed species, crops, climate and altitude. Nobody has yet mapped the weed population of Britain and the proposed survey may lead to unexpected conclusions, as weeds must vary in importance from one district to another.

If the census is repeated in, say, two or three years' time, it should indicate what changes in the plant population have been taking place as a result of the control of weeds by chemical means.

Heart Ruling Head

THE WEST IS PASSING THROUGH a sentimental phase which has invaded many aspects of life—political, social and even agricultural.

About 30 years ago there was strong agitation against the use of artificials on the farm and much airy talk about the superior value of composts, in spite of the fact that they can only be made by taking vegetation from one area to convert into organic matter for another. Paul is thus paid by robbing Peter. Even when analysis showed that crops grown by hydroponics with chemical plant foods were identical in every way with those grown on compost the sentimentalists refused to recognise the fact. 'There is something . . . ', they claimed, but were never specific.

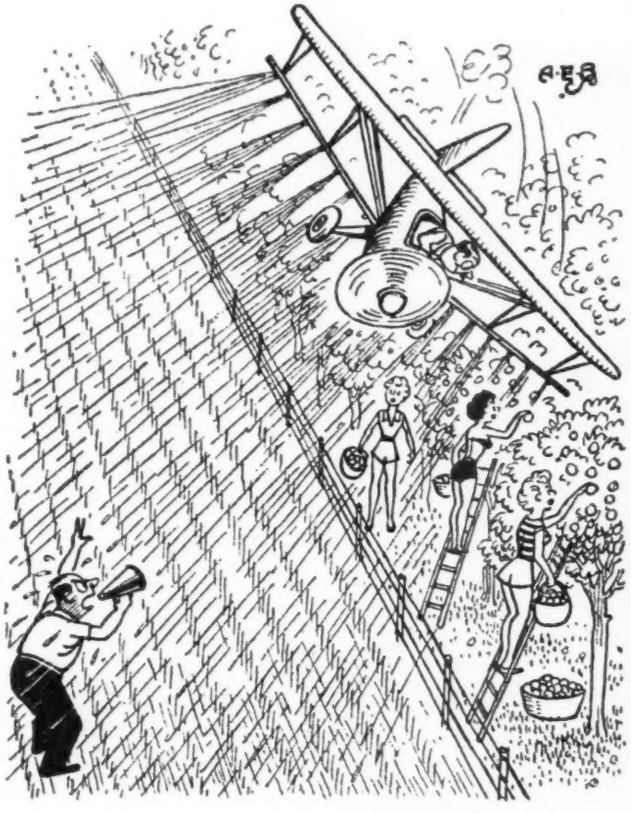
About 1935, when more effective pesticides were being produced and better spraying machines were being developed, the sentimentalists were against them. Not only would resistant strains of pests be evolved, they said, but pest depredators would be destroyed and a natural form of control thus eliminated. Whether these protests were based on a feeling for the insects or merely on an invincible opposition to advancing science is not clear, but farmers have employed the new controls and have realised amazing crop increases through their use.

The *Farmers' Weekly* for 17 February, 1961, produces a note by the British Egg Marketing Board and records that 20% of our eggs are produced by battery birds. Many people are shocked by the idea of egg production in this way; it is unkind to the birds and eggs from this source are inferior to those laid by free-range hens, they say. However, a taster's panel in London recently failed to detect any difference between battery and other eggs.

Sentiment may, in due course, rob the West of its initiative. Yet it is a hopeful sign that farmers are applying more artificials and insecticides than ever before and will, no doubt, be sending more battery eggs and chemically-treated produce to the market in future. How else are the sentimentalists to be fed? How else can our civilisation go on?

Straws in the Wind

A PROPOSAL THAT the future population of Luton and Dunstable should be restricted has been made by the Bedfordshire County Council. The Council is sponsoring a Bill for developing new supplies of water from the River Ouse, as the area was having severe difficulties over water supplies; it was anticipated that this proposal would meet all foreseeable water needs for at least 40 years.



'Keep your mind on the job, Joel'

It was hoped that the additional supplies of water would be available by 1966, but the planning authority could not be certain of this. For that reason it was thought to be sensible and prudent to limit population, for once the population reached 175,000 (now 160,000) there would be supply difficulties at times of peak demand, during droughts or frosty weather. If building continued at the present rate of 2,400 houses a year, that situation would be reached in 1963.

Another aspect of the same problem was referred to on page 123 of our April issue. Taken together, they indicate that water, the supplies of which are in some areas unlimited, in others can be the limiting factor in population. The conflicting demands for this essential commodity come from the industrial consumers, domestic users and the farmers, commercial growers and market gardeners of East Anglia, whose job it is to produce more and still more food and who require more and still more water to meet the growing needs of the ever-increasing population of Britain.

Charity and Aid

THE ORIENT HAS ALWAYS BEEN NOTORIOUS for the cult of the begging bowl—an instrument provided not so much to assist the needy as to make it possible for the passer-by to exercise the virtue of charity. The money is received as impersonally as it is given.

Hundreds of millions of pounds have already been advanced in foreign currency and a great deal has been done to meet the immediate necessities of hunger and disease. But can it be said that the people of the 'emerging' countries are, in fact, advancing along the road of true progress?

There are a few show-pieces—steelworks, aeroplane factories, irrigation and power schemes—but is the agriculture of these countries really advancing in parallel with the astonishing progress in the Western world? Frankly, it is not, and disaster lies ahead unless the leaders in the recipient countries respond and do not allow the operations to be sabotaged by administrative inefficiency, idleness, corruption and indifference to the needs of others.

Time is not on our side. People continue to be born in these countries in terrifying numbers. Yet can it be said that any one of the newly self-governing countries —with the possible exception of the Federation of Malaya—is a picture of political and economic stability? Are the people as a whole better off than they were under the previous colonial regimes?

Foreign aid is charity where the response is inadequate or where one great nation is being played off against another. Donor countries are entitled to expect a proper response in the form of material increases in crop yields, for aid is not really given for the benefit of a recipient country alone. They expect results which will add to the health, wealth and happiness of all mankind.

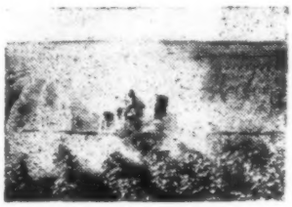
Xerophytic Fodder

WE HAVE LEARNED THAT a promising fodder species for arid tropical regions has been recently found in Somaliland and the Ogaden region of Ethiopia. It is *outoro* or *Cordyla somalensis*, a small tree or shrub, usually found on gravel and sandy soils growing to a height of about 10 ft. It is an extremely xerophytic* species, needing an annual rainfall of only 10 in.

The report states that it is grazed by all types of stock and as it also produces a large edible seed it may prove to be of value as an economic crop for other regions in the arid tropics.

Unfortunately, as is to be expected, it is at present being subjected to increasing over-grazing and, like some other plants in such regions, may soon be exterminated in the 'Horn of Africa'. Obviously the urgent need is for trials at experiment stations and the conservation and multiplication of approved seed to meet future requirements.

*Xerophytic: a plant adapted to dry conditions



This Month's Cover Picture

Cotton growers have found that 'Sevin' insecticide can be used with greater safety to the operator than the older insecticides. Excellent yields of cotton seed have been recorded following its season-long use—yields far higher than those obtained in the untreated check fields and often better than the best of the standard treatments. The speed of knockdown of this insecticide against some cotton pests closely approaches that of the more dangerous phosphorus insecticides; against others the speed of knockdown is slightly better than with the chlorinated hydrocarbons.

'Sevin' has given enduring results and effective control of the boll weevil, *Anthonomus grandis*, cotton fleahopper, *Psallus seriatus*, and bollworms, *Heliothis zea*, where these insects have developed resistance to other insecticides. It works even better in hot weather and is not decomposed by strong sunlight.

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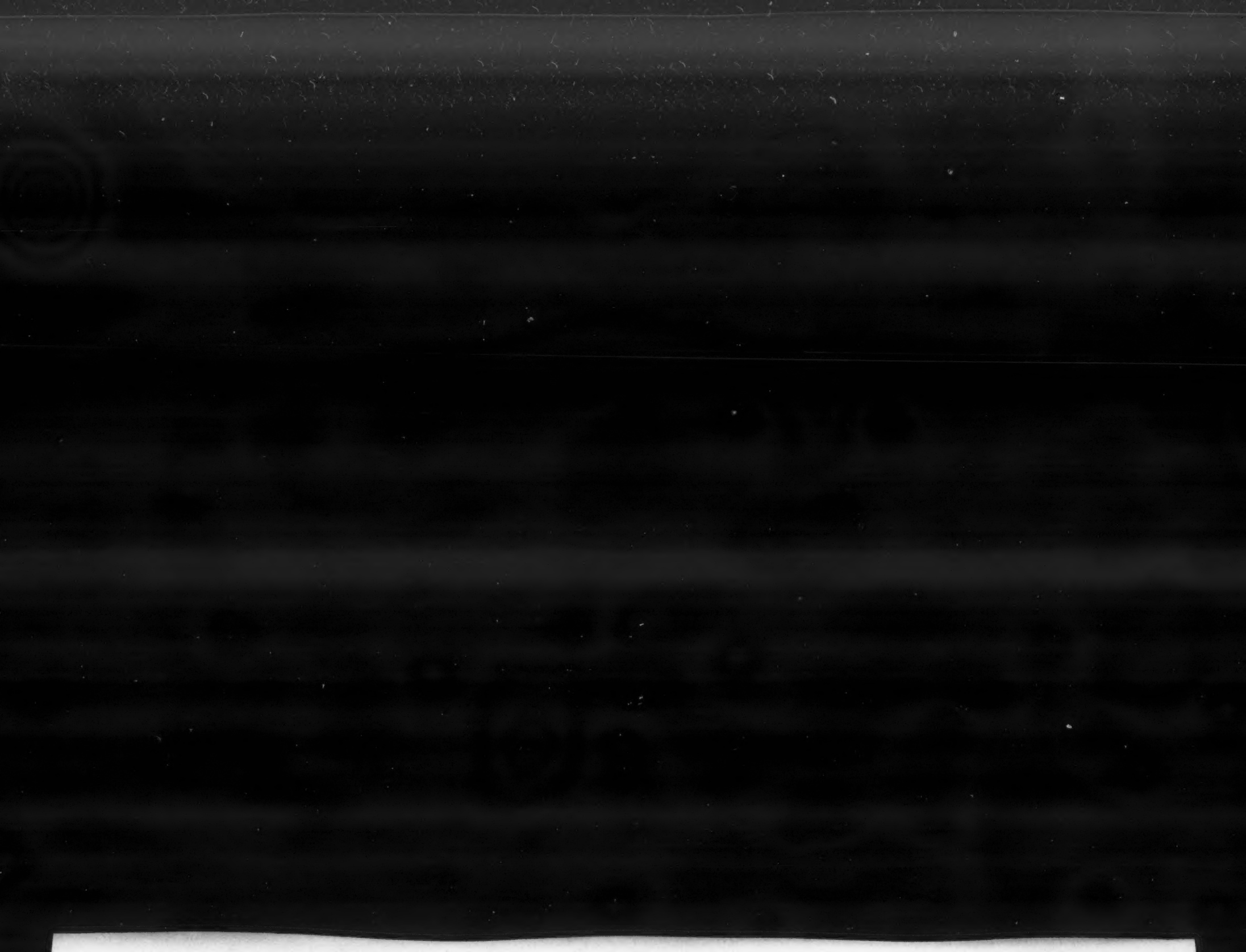


A Tiger Moth aircraft, fitted with four Britten-Norman rotary atomisers, being used by Crop Culture (Sudan) Ltd. to spray cotton. Flying almost at ground level, the wheels brush the tops of the cotton plants

Protecting Cotton in the Sudan

A. M. TOMS,* N.D.A.

Much work has been done in recent years to determine the best methods to use for the protection of cotton in the Sudan. In 1955, the author wrote an article entitled 'Spraying Techniques and Machinery in the Sudan Gezira', which appeared in two parts in the August and October issues. The present article brings the position up to date, particularly with respect to the use of low-volume sprays.

BOTH short-staple American type cotton and the world-renowned long-staple Sudan cotton are grown in the Sudan. The American type is grown chiefly in Equatoria and the Nuba Mountains; the area varies from year to year, but is generally about 200,000 acres.

Cotton pests

This cotton is rarely treated against insect pests, as it is not ecomonical to spray it, although some indirect measures are taken against stainer bugs, *Dysdercus* spp., flea beetle, *Podagrica puncticollis*. These pests appear to be on the increase in some of these areas and some control measures may be necessary.

The long-staple Sakellarides type of cotton is grown by pump or gravitational irrigation along the banks of the Blue and the White Nile and in the triangle of the Gezira formed by these two rivers before their confluence at Khartoum. It is also grown under flood irrigation in the Gash and at Tokar, but the area is very variable, being dependent upon the flood of the Gash and Baraka rivers.

In the Gash, the Sudan bollworm, *Diparopsis castanea*, is a pest of economic importance, but it is most difficult to control, whilst in the Tokar Delta, no insect pest has proved of economic importance, the yield-controlling factor being physiological bud and boll shedding from cloud effects.

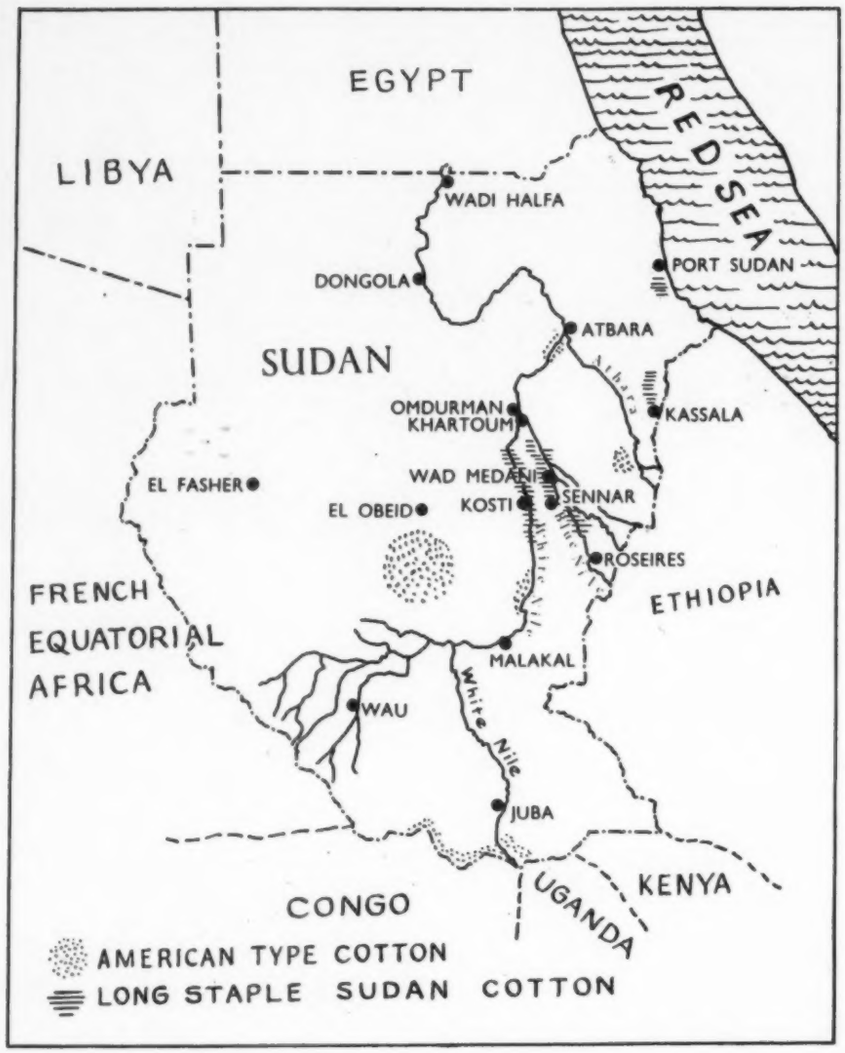
The areas under pump or gravitational irrigation are about 400,000 acres in the Gezira covered by the Sudan Gezira Board (S.G.B.), some 15,000 acres by the White Nile Schemes Board and some 200,000 acres on private estates.

In these areas, the chief pests are flea beetle, *Podagrica puncticollis*, thrips, *Hercothrips* spp., jassid, *Empoasca lybica*, whitefly, *Bemisia tabaci*, and in the more southerly areas cotton aphis, *Aphis gossypii*, whilst American bollworm, *Heliothis armigera*, and spiny bollworm, *Earias insulana*, are occasionally of importance. Pink bollworm, *Platyedra gossypiella*, is also present, but is kept well under control by strict phyto-sanitary measures.

Pesticides used

Since 1945, DDT has been the standard insecticide for controlling flea beetle, thrips and jassid, but its use results in an increase in the infestation of whitefly and aphis. More recently, endrin has been introduced because it will successfully control thrips, jassid and whitefly, and the aphis population does not appear to build up seriously after its use.

* Spraying Officer, Sudan Gezira Board.
This paper is published with the permission of the Sudan Gezira Board.



Aphicides are comparatively new introductions and those principally used are 'Metasystox', 'Ekatin' and 'Rogor'; the two latter are also being used experimentally for jassid and whitefly control. Other insecticides are continually being tested at the Gezira Agricultural Research Station at Wad Medani and are subsequently used in the field, according to recommendations.

Method of application

The method of application varies with the locality. In the Gezira the S.G.B., with its large fleet of tractors and a compact area, concentrates on tractor spraying; aircraft are only used in an emergency because aerial spraying is the more expensive method.

The private estates, however, have very different spraying problems from the S.G.B.; they do not have large fleets of tractors on which to draw, they consist of a large number of comparatively small units scattered over a wide area and water is not so easy to control as with the gravity irrigation of the Gezira. Further, due to aphis attack, they often have to carry out spraying much later in the year, when the height of the crop makes tractor spraying almost an impossibility. The principal handicap, however, is the dependence of these innumerable small growers upon a few contractors, as well as the factor of cost.

Aerial spraying

The method of aerial spraying depends very largely on the contractor, both the spinning-cage atomiser and the usual boom equipped with nozzles being successfully used. The type of aircraft also varies, but, providing it is well flown, any suitable type can be used. Flying height above the crop is important; spraying should be done with the wheels practically touching the plants. This is because with the hot upward air currents experienced during the spraying season, and the small droplet size essential for good coverage with low-volume spraying, there can be loss of insecticide on the crop both from evaporation of the water and from spray drift unless this low flying height is maintained.

The swath width used generally is 20 m., which corresponds usually with an angia;† this can be clearly seen from the air and so does away with the need for ground markers. The volume sprayed per acre varies from 1 to 2 gal., the lower volume being satisfactory only under perfect flying conditions. High winds and bumpy air conditions often hold up aerial spraying and so reduce the number of flying hours possible during the day.

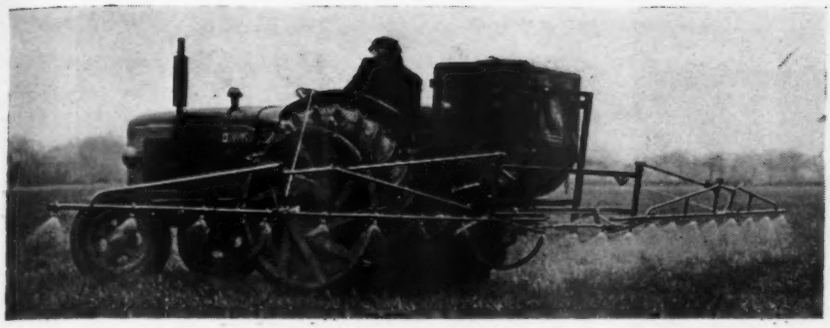
Ground spraying

In the Gezira, tractor-mounted spraying machinery has been found to be the most suitable. To overcome the difficulties caused by the vertical movement of the spray booms, particularly when crossing the low ridges of the irrigation ditches, spring-loaded booms are the best type to use. These absorb most of this vertical movement and prevent its transmission on to the back frame of the machine, thereby reducing some of the strains imposed on it.

The water used for spraying is taken from the irrigation canals and during the spraying season it contains a high proportion of colloidal clay in suspension. This tends to congeal with the chemical behind the orifice of the ordinary low-volume nozzle, even when the finest screens are used. A system of spraying using wide-angle nozzles has therefore been developed; these give a satisfactory coverage of the plants and, due to their large orifices and the absence of swirl chambers, seldom become blocked.

Four nozzles are fitted on a 40-ft. boom, each nozzle having a swath width of 13 ft. 6 in., giving a total overall swath of 54 ft. This is equivalent to 20 rows of cotton sown in 32-in. rows—the standard Gezira practice. This type of machine, when

† Angias are the division of the fields by cross-ridges and ditches for irrigation. There are usually 14 in each field.



A tractor-mounted boom sprayer fitted with wide-angle nozzles to give no-drift application

applying 7½ gal. of spray per acre (*i.e.* about 20 acres per filling with the two saddle-mounted tanks together holding 150 gal.), is able to treat at least 150 acres in a 12-hour day; it is indeed not uncommon for up to 230 acres to be covered in a working day.

Toxic hazards

The only insecticide used until recently, DDT, was a relatively safe insecticide and no special safety precautions were then needed. After the introduction of insecticides with a higher mammalian toxicity, such as endrin and 'Metasystox', special arrangements have had to be made to diminish the toxic hazards to both operators and the general public in close contact with the spraying operations. This has been achieved successfully by publicity through the local government authorities. With their close co-operation not only have tenants and workers been warned of the toxic hazards associated with the use of these insecticides, but schoolchildren also have been instructed on the dangers of interfering with chemicals which can be highly poisonous.

It has been found when using endrin that, providing simple personal hygiene precautions are taken and common sense is used, then the danger is greatly reduced. In the tropics it is impossible to insist that the spray crews wear all the protective clothing which is recommended for work in temperate climates, such as oilskins, rubber boots, gas masks and rubber gloves. Long-sleeved shirts of white cotton and long trousers can be worn in the tropics and their cleanliness enforced; also it is feasible to compel them to be worn. As is stressed by most toxicologists, the use of soap and water is most important and, as water is plentiful there, a free issue of soap means that personal cleanliness can be enforced.

The main danger with all toxic insecticides is in the handling of the concentrate and although PVC gloves are useful for this purpose, there is always the danger of giving the operator a false sense of security, for he may neglect to wash before taking off his gloves. Thus skin contamination is often increased instead of reduced. This applies also to other protective clothing, such as oilskins and rubber boots.

Spray drift hazards

The technique of tractor spraying using wide-angle nozzles tends to reduce the poisoning risk, since there are only four nozzles to keep clean and very fine droplets are almost eliminated from the droplet spectrum, thus reducing the risk of drift on to the operator. Similarly, hollow-cone nozzles with special swirl chambers for eliminating the very fine droplets and reducing, or even almost eliminating, drift are an advantage when using toxic chemicals.

Although aircraft must be used in some areas, there is little doubt that, as regards the risk of affecting neighbouring food crops, tractor spraying is much safer. Also, as far as endrin is concerned, its very high toxicity to fish has been a nuisance in that even a slight spray drift from aircraft into the irrigation canals has been responsible for killing large numbers of fish. Although these have been eaten by the local population without apparently any ill effects, the dead fish have on occasions blocked irrigation pipes and channels.

Organisation and supervision

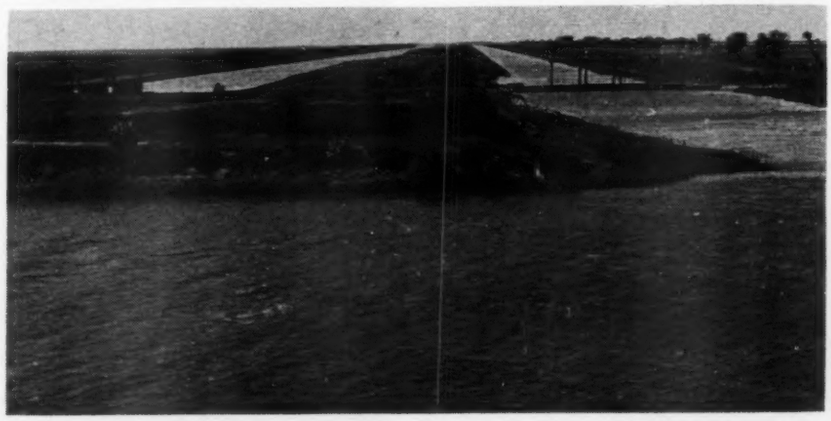
The Sudan Gezira Board annually spray an area of over 350,000 acres in one month by tractors and this requires very considerable organisation and supervision. This is effected by making each inspector in charge of one of the blocks‡ into which the scheme is divided, administratively responsible for the spraying of that block.

The machines are operated and maintained by the Ploughs Section of the Mechanical Engineering Department, each mechanic supervising eight to 10 machines. The Spraying Department of the Board is responsible for the initial deployment of machinery, the full technical details of each operation and the liaison between the mechanical and administrative sections. In this manner the work is carried out speedily and efficiently.

Minimum of spraying

The Gezira scheme has been fortunate in that to date it has been

‡ Block: an administrative area of approx. 16,000-28,000 acres gross area or 4,000-7,000 acres actually under cotton.



The two main canals which carry the irrigation water to the new Managil extension to the Gezira scheme and an additional 1 million acres are now being brought under cultivation

Inter-row cultivation of cotton in the Sudan. Left: *The old way—one row at a time.* Right: *The new way—three rows at a time*

possible to control most of the more serious pests with only one spraying; further south on the private estates they have not been so fortunate, for the very early thrips attack and the late aphis infestations have necessitated two and sometimes three sprays.

Every endeavour is made in all areas to keep the number of sprays to a minimum, as, apart from the cost, there is always the danger that the more sprays that are given to the crop the greater the danger that the insect complex will change, necessitating even more sprays. This already seems a possibility in view of the increase of bollworm infestations in certain areas where it has been essential to use organo - phosphorus insecticides to bring heavy aphis infestations under control.

The Bug Buster

Device for Attracting and Destroying Insects

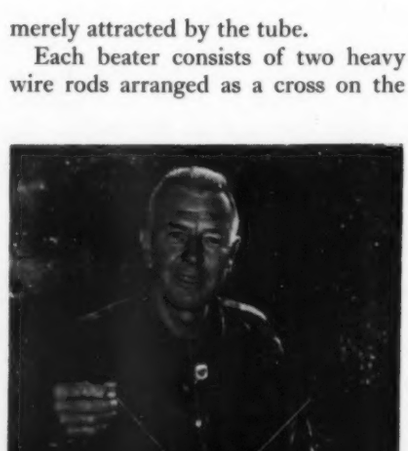
T. A. DICKINSON

AN interesting and inexpensive device has recently been invented by a Southern California apple grower, Mr. Paul Stevens, for attracting and beating to death the large numbers of insects which are active in his orchard at night.

The inventor considers that it is a valuable auxiliary to the use of insecticides in that it will give a considerable degree of protection to crops immediately prior to harvesting, when the danger of toxic residues makes it unwise to use many of the usual pesticides. He has found, too, that it is particularly effective against the codling moth.

The device consists of a 15-watt 'black light' or U.V. tube and two cross-wire beaters which are simultaneously rotated by a small 1/100-h.p. electric motor. The tube, a standard electrical product, will attract and kill certain insects; the rotating beaters are to destroy those which are merely attracted by the tube.

Each beater consists of two heavy wire rods arranged as a cross on the end of a rotating shaft; the motor which turns them has been geared down to 1,000 r.p.m. to avoid overheating. A toggle switch is used to turn the device on at sunset and off at dawn.



The inventor, Paul Stevens, of Oak Glen, California, with his 'Bug Buster'

The machine uses the standard 110-volt alternating current, and the inventor states that his power bills to date have shown that the operating cost is less than 20 cents per month.

The bodies of dead insects are evidence of the effectiveness of this simple machine. Even more impressive is the fact that there were few signs of any insect damage on the apples of the nearest trees, whereas the apples grown some distance away were frequently 'wormy' in spite of the application of insecticides.

This insect destroyer might be even more effective with row crops than in an orchard because a light can attract even more insects when it is not hidden by foliage.

Progress in Crop Protection

E. HOLMES,* M.SC., PH.D., F.R.I.C.

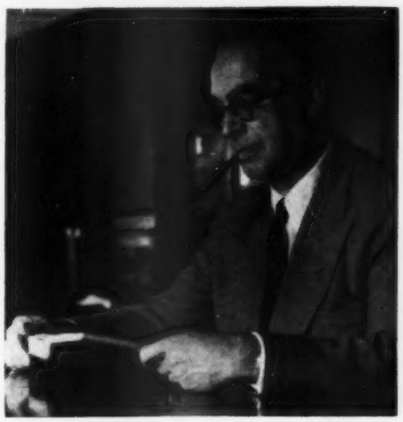
The author of this article has travelled widely in four continents and has an enviable knowledge of crop protection problems and overseas conditions.

IMMEDIATELY after the last war I travelled up and down the length of Africa for some months. My main job was to make new and revitalise old contacts with workers at universities, agricultural colleges and research stations interested in the broadest aspects of crop protection. I also visited many farms and addressed large technical and farmer audiences. It so happened that I was accompanied for most of the time by a colleague interested in the more medical and veterinary aspects of the new insecticides developed during and immediately after the war years.

Although there was great interest in the information we were able to give on the potential uses of the newer insecticides for control of, say, locusts, codling moths, maize borers, mosquitoes and ticks, my outstanding memory of that period was of a quite different but parallel topic.

In the course of general conversation we talked of the new developments in medicine: penicillin, the sulpha drugs and the new anti-malarials. We found the response of the medical fraternity somewhat apathetic. Their general attitude was: 'What is the good of us saving the lives of tens of thousands by preventing disease if they are then to die from starvation'. They were not very impressed by the argument that a larger number of healthy agricultural workers should produce more than sufficient additional food to compensate for the extra mouths.

More recently, I remember talking to a research worker from the Far East, who told me that about a thousand farm workers had been killed by a recently introduced insecticide. This was a catastrophe, but had to be viewed in the light of the fact that the treatment produced enough additional rice for a million people to be saved from starvation. While this was certainly a realistic attitude, it scarcely commends itself to any Western nation!



Dr. E. Holmes in his laboratory at Fernhurst Research Station in Surrey

Agricultural chemicals necessary

All of which brings me to a point, often enunciated, but still not sufficiently widely accepted. If we are to improve the food intake of the great majority of the world's population, or to feed the rapidly increasing world population even at the present low level of intake, one of the methods of increasing food supplies must be the extended use of crop protection methods. And, despite the lucubrations of the popular press and even more sober journals, it is the considered opinion of all responsible workers in agriculture that, in the light of present knowledge, agricultural chemicals—insecticides, fungicides, weedkillers and so on—must play the greater part.

It is fair to say that the majority of present-day agricultural chemicals involve such small undesirable side-effects that these are negligible in relation to the enormous and ascertainable benefits to mankind. It is admitted that a few chemicals which are very beneficial to agriculture carry hazards to man, domestic animals and wild life.

The short-term objective must be to devise ways and means of employing the chemicals in this second category in such a way as to minimise hazards of all kinds. The long-term objective, quite obviously attainable ultimately, but uncertain in timing and extremely costly, is to discover newer products as effective, or nearly as effective, but much safer, than the old. Every responsible chemical manufacturer is very well aware of these facts, is proceeding on these lines and, to put it at its lowest, is well aware of the rewards awaiting the solution of these problems.

I have said that the benefits from crop protection are ascertainable. This is an over-simplification. Certain direct benefits may be calculated in pounds, shillings and pence; many benefits are less tangible though very real.

By way of example, it can usually be demonstrated that the use of selective weedkillers in cereals gives increased yields of the order of 15-25%, the value of which far more than covers the cost of the chemical and its application. It actually does much more: it makes harvesting easier and therefore less expensive; it makes cleaning of the grain easier; it allows favourable variations in cropping procedures. But it is quite difficult to put a cash figure on these operating benefits.

Let us now turn to a few specific examples of the successful use of crop protection, see what has already been achieved and indicate what might be done by extending those uses.

Cacao capsid control

Dealing with an insecticide first, we may take the case of capsid control on cacao in West Africa with gamma-BHC. The writer has recently dealt

* Director of Plant Protection Ltd.

Mature cocoa defoliated by capsid in Nigeria

with this subject so far as concerns Ghana at some length,[1] but the main facts may be emphasised.

As soon as it became evident that the swollen shoot virus disease could successfully be halted by an enlightened cutting-out schedule it was established that the next most important problem was control of capsids which suck the sap of the foliage, defoliate trees and reduce yields so drastically.

Following a large programme of experiments carried out by the West African Cocoa Research Institute (W.A.C.R.I.) at Tafo, the Ghanaian Department of Agriculture at Bunso, and by my own company, it was established during the years 1955-58 that a liquid formulation of gamma-BHC, used according to a predetermined pattern of application, gives excellent control of the pests, allows recovery of an adequate canopy of leaves on the cacao trees and results in very considerable increases in cocoa yields.

The forecast increase in cocoa yields for Ghana, calculated on the consumption of insecticide during the past few years, has indeed been realised. Pickings during 1960-61 are phenomenal by any previous standards and 412,500 tons were purchased from producers up to 23 February, 1961. This makes a season's total of 450,000 tons virtually certain compared with not much more than half this total only five years ago.

The effect of this remarkable increase in the production of cocoa was a temporary world surplus and pessimists inevitably predicted a very gloomy outlook for the cocoa trade in general. But, although the price of cocoa has fallen from an average of £285 per ton in 1959, through £225 in 1960 to a present price of £170, and by May 1961 may have fallen as low as £155,[2] the remarkable thing is that the total cash value of Ghana's cocoa exports have steadily *increased*. This is surely a satisfactory state of affairs in view of the healthy long-term outlook for cocoa (see graph).

In the cocoa market, the future is seen to be bright because even at a price of £200 per ton, cocoa was cheap enough for rapid development of

Cocoa capsid spraying in Ghana

the chocolate market and the potential world consumption is very much larger than the present level of consumption, which is related to cocoa prices of £250-£300 per ton.

At the new price levels the manufacturing industry can hold adequate cheap stocks and, with such a buffer, the violent price fluctuations of the past few years need not recur. Courageous production schedules can be planned with far greater confidence because there will be less risk of highly significant price variation in the principal raw materials. The present surplus is not expected to last long in the commercial climate created by being able to buy cocoa at £150-£200 per ton.

Sugar-beet aphid control

Another outstanding example of the advantage of adopting measures to prevent infestation by insects is that of aphis control on sugar-beet in the U.K. During the years 1946-58 Dr. Hull and others[3] of the Rothamsted Field Station at Dunholme, Lincolnshire, estimated that the average loss due to virus yellow attack was 0.92 tons per acre per annum, the highest being in 1957, when the loss was given as 2.60 tons per acre. This latter figure is seen in proper perspective when it is converted to a loss of sugar that year of approximately one million tons—as severe a loss as, if not more than, any previously recorded.

Experiments with insecticides likely to reduce this loss by controlling the aphis vector of the disease had, of course, been in progress for many years, but it was not until the organophosphorus insecticides became available that the efficiency of control was adequate. The coming of safer organophosphorus insecticides which were systemic in action and of long persistence gave the farmer not only an adequate technical performance, but also a material of practical value because of the relative lack of hazard to the spray gangs themselves.

Experiments with these safer organophosphorus sprays have been carried out by Dr. Hull, in collaboration with the British Sugar Beet Corporation, for many years and the effects of spraying are summarised[4] in Table 1.

This table, however, does not contain the astonishing results obtained in 1959, which are also quoted by Hull.

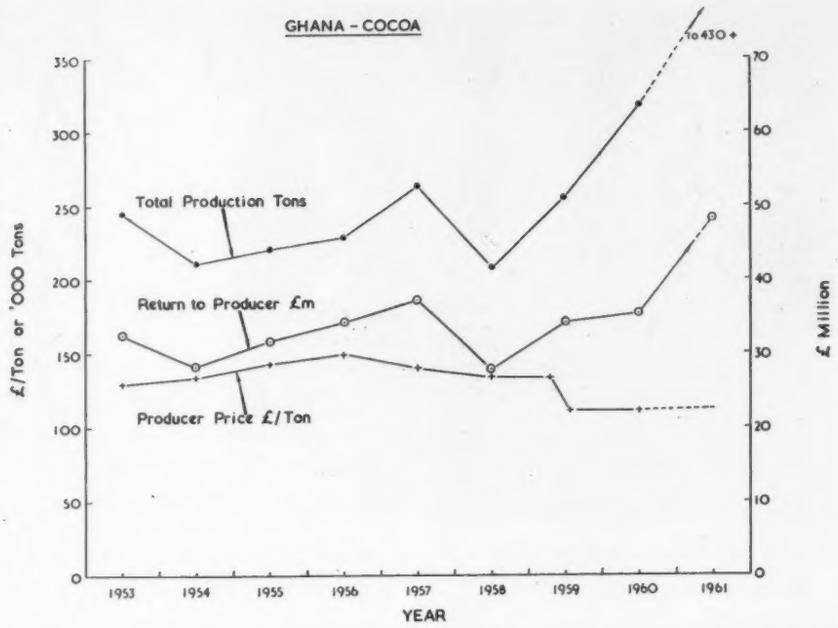
Regrowth of cocoa after 'Gammalin' treatment against capsid

He draws attention to the very large increase in yield (26%) obtained as an average in recorded crops covering most of the sugar-beet-growing areas of the country.

The summary results from a trial conducted at Kentford in 1957 enable us to compare the approximate value of this increased yield with the cost of achieving it. They are shown in Table 2.

The maximum advantage obtained was £20 per acre, as compared with the maximum cost of two sprays at £1½. From this it may be deduced that the average increase obtained in 1959, as quoted by Hull, was worth at least £14 per acre at present values.

When it is considered that the U.K. produces on some 400,000 acres only about 0.8 million tons of sugar as compared with 2.3 million tons imported, it is obvious what could be done by improved methods on greater acreages if it were politically desirable.



Cereal seed dressings

In the case of cereal seed dressings in the U.K., we have an example of the very widespread use on the one hand of the fungicidal, organo-mercury dressings to control seed-borne diseases and on the other the combined fungicidal-insecticidal dressings mainly to control wireworm, but also wheat bulb fly in addition to fungi. Both types of dressing are so cheap per acre in relation to the benefits that it is estimated that sufficient is sold to treat between 80% and 90% of all the cereal seed sown in the U.K.

Because the mercurials have been so widely used since about 1930, bunt of wheat, which was originally by far the most important of the diseases of wheat has virtually disappeared. Further, it is conservatively calculated that by the control of the minor diseases, such as foot rots and seedling blights, and the control of wireworms, the resulting benefits to the U.K. are equivalent to some £10 million worth of extra grain per annum.

Obviously the practice is so widespread in the U.K. that the likelihood of bettering this particular performance is poor. On the other hand, there are very large areas of other cereals in other parts of the world, particularly in the less developed countries, where the increased use of these dressings could make very significant contributions to their food production. What is even more important, the contributions would be made in the areas where they are most needed.

Table 1

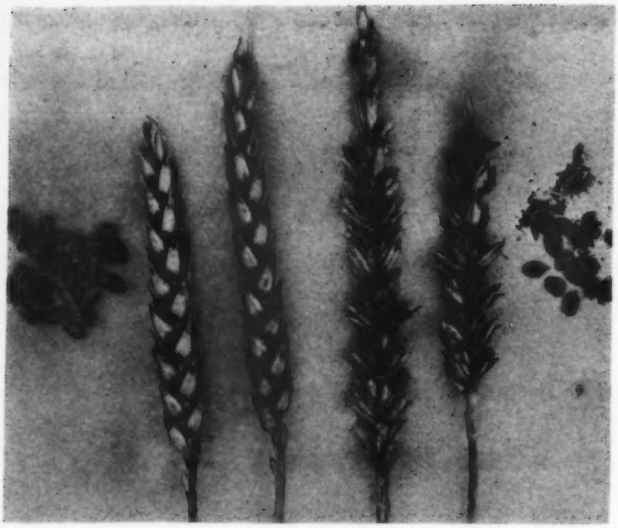
Proportionate sugar yield resulting from spraying with insecticide (unsprayed = 100)

No. of experiments	*Year*	*Early sprayed*	*Late sprayed*	*Early and late sprayed*
9	1958	108	107	112
18	1957	113	104	117
1	1956	106	108	105
3	1955	112	105	111
6	1954	110	—	—
4		117	107	117

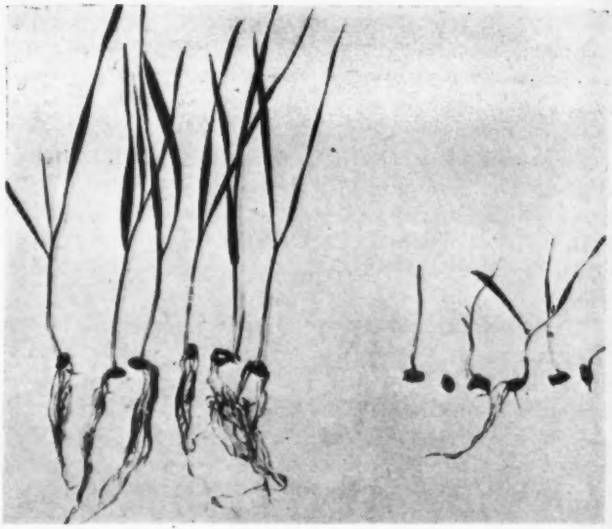
Effect of 'Metasystox' on sugar-beet. The beet in the top half of the photograph was twice sprayed with 'Metasystox' at 12 fl. oz. in 50 gal. of water per acre. The unsprayed sugar-beet in the foreground is suffering badly from virus yellow

Cereal protection in Turkey

Let us take as an example the one-time wheat importing country, Turkey. In 1948 the average grain yield of the 10 million acres of wheat in that



Bunt is a seriously destructive disease (right). Healthy grain and heads of wheat (left)



Wheat seedlings suffering from Fusarium compared with healthy seedlings on the left which were treated with a seed dressing

country was just under 8 cwt. per acre and it was apparent that the major factor limiting yields was water availability; most of Turkey's wheat belt on the Anatolian plateau is in a region of 12-18 in. of rainfall. However, because the response to nitrogen fertiliser in these conditions was low, it was realised that one of the most important considerations was to take all possible steps to improve seedling growth.

Table 2

Kentford, 1957—Summary of results

Observations	*No spraying*	*Early spray*	*Late spray*	*Early + late sprays*
Yellows, % (end July) ..	81	43	71	38
Yield (tons/acre)	10.8	13.9	12.8	13.8
Sugar (cwt./acre)	28.1	38.1	34.7	38.4
Cash value/acre	£56.7	£76.7	£69.4	£76.7

It was realised that soil fungi were taking a high toll all over the country and the Government very properly decided to organise mobile seed dressing stations. It was realised that the urgency of the need to adopt up-to-date seed protection techniques could not be met by waiting for farmers to develop this consciousness themselves. By 1951 the level of activity in cereal seed protection in Turkey was high by any standards; approximately 450 combined seed dressers and cleaners were distributed all over the country and the Ministry of Agriculture purchased centrally, for use in these seed treatment stations, 800-1,000 tons per annum of a 1% mercury seed dressing. This very large-scale adoption of modern seed dressing techniques was undoubtedly the major cause of the gradual increase in yield per acre.

In 1954 the first large-scale activity against two other pests which deprived Turkey of a large proportion of the wheat which would grow was organised. Weed control by aircraft application was introduced by my company and in the following year aircraft treatments of the infamous Senn pest were begun. It is indicative of the progressiveness of the Turkish Ministry of Agriculture that approximately 1.46 million acres of wheat were treated by air up to December 1959.

The average yield of wheat in Turkey in 1958 was nearly 9½ cwt./acre, a rise of 18% in 10 years. This for over 18.7 million acres of wheat is no mean achievement, representing as it does an extra 1.3 million tons of grain per annum.

Conclusions

It is not possible in this short article to give all the examples of the value of crop protection chemicals and those examples quoted are admittedly rather miscellaneous. It must be pointed out however, that, despite an enormous literature, clear-cut examples of specific benefits are not so well documented as one might imagine or would wish. Nevertheless, it must be obvious that the extension of such measures, particularly in the less well-developed territories, could make significant contributions to the need for increased food supplies.

It is interesting to find that FAO is proposing just such a programme to the pesticide industry for particular application in South-East Asia, the Near East and West Africa as part of its Freedom-from-Hunger Campaign.

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2. Gill and Duffus: *Cocoa Market Report*, March 1961, 134.
3. *Plant Pathology*, 1959, 8, 4.
4. *Brit. Sug. Beet Rev.*, 28, 3, 114.

NOTE FOR CONTRIBUTORS AND AUTHORS

The editor welcomes authoritative articles and news items on agricultural machinery and agricultural methods, agricultural crops and new developments.

A short synopsis should preferably be included to assist the editor and the manuscript itself should be typed in double spacing with plenty of margin and on one side of paper only.

It should bear the name and address of the author and be accompanied by sharp photographs or line drawings with suitable captions.

Progress in Weed Control in Malaya

K. F. KAVANAGH

During 1961 the ban on the use of sodium arsenite will become effective in Malaya. The important plantation industries, on which much of the wealth of Malaya depends, will have to modify their weed control practices and this article outlines the results of some of the work which has been done during the past two years to make this possible.

THE Malayan climate, with its perpetual summer and heavy well-distributed rainfall, encourages rapid growth, not only of crops, but also of unwanted vegetation; weed control in agriculture is therefore one of the major factors in production. In peasant agriculture, as in other countries, hand weeding is still the method of control used.

Chemical weed control

However, since the war the important plantation industries have come to rely increasingly on chemical weed control for maintenance, supplemented by manual weeding only where made necessary by the limitations of the herbicides used or the cover plant policies practised. The use of chemical weedkillers became important when the large acreage of rubber neglected during the Japanese occupation had to be rehabilitated at the end of the Pacific war.

Sodium arsenite was the chemical chosen for its effectiveness, speed of action and simplicity in use, and its determined and widespread use in the rubber industry helped clear the overgrown estates quickly. Continuous and general application of such a highly toxic chemical as sodium arsenite has given rise to serious and growing concern. The exposure of a large labour force over long periods, especially under tropical conditions, presented serious health hazards and, in addition, despite warning notices posted by all estates, there has been a considerable loss of livestock through grazing sprayed herbage.

There has been a growing movement in official circles in Malaya to abandon the use of sodium arsenite and the necessary legislation was introduced during 1960 to effect its complete withdrawal by the summer of 1961. The use of sodium arsenite had, however, become so widespread and important that its withdrawal has posed a major problem to the plantation industries.

New chemicals

Fortunately, the chemical industry brought forward a range of non-toxic herbicides which have been evaluated in the past two years in Malaya and which will enable the industries concerned to maintain or even improve the present high standards of maintenance effectively, economically and safely.

The chemicals which will be used include contact herbicides of short persistence (such as sodium chlorate), translocated herbicides (such as dalapon and aminotriazole) and persistent herbicides for 'preventive maintenance', such as simazine and atrazine. Between them these chemicals provide the plantation industries with the necessary chemical armoury and suitable mixtures will deal effectively with most of the problems.

The two triazines, simazine and atrazine, are very sparingly soluble chemicals applied as wettable powder sprays, which kill the seedlings of broad-leaved weeds and grasses by root absorption once rainfall has taken the weedkiller into the top 1-2 in. of soil. Due to the low solubility of simazine and atrazine, the chemicals remain active in the soil for several months, even under tropical rainfall.

RUBBER

Malaya is now the largest producer of natural rubber in the world and its 3½ million acres are the most important single factor in the economy of the country. There are five distinct weed control problems: in nurseries; in old or uneconomic areas prior to clearing; in cleared areas ready for replanting; during the period of establishment of newly planted rubber and covers; and in the maintenance of weed-free planting rows in immature rubber. There is occasionally a need for weed control also in mature rubber, but this is becoming of less importance, as weed growth during the period prior to maturity is often prevented in replanted areas by the use of leguminous covers.

Weed control in nurseries

The close planting in nurseries at 1 ft. x 1 ft. makes manual weed control difficult or impracticable. For chemical weed control in nurseries, persistence is necessary to maintain continuous clean-weeded conditions and a sound treatment is the use of 7½ lb. of Simazine 50W, applied as a spray over clean-weeded ground at 12- to 15-week intervals. Application should not be made on to seedlings less than three months old.

Replanting areas

In old areas ready for replanting, a cover of grasses and other weeds is generally present. The eradication of this growth, before and following the felling or poisoning of the trees and burning, has been an important field of use for sodium arsenite in the past. Mixtures of dalapon, aminotriazole and sodium chlorate can be used as effective non-persistent herbicides and the addition of atrazine has been found to give greatly increased persistence.

Once an area has been cleared for replanting a period of time may elapse before cover plants are established and new rubber planted. During this period it is necessary to prevent weed

growth from establishing itself, and simazine or atrazine have been used successfully alone, or in mixtures with contact herbicides, to maintain weed-free conditions.

Establishing leguminous covers

The most common policy for controlling soil erosion and ensuring the rapid growth of newly planted rubber is to establish a good ground cover between the tree rows with leguminous creepers, which are rich in nitrogen and provide shade for the soil. The establishment of such legumes—generally a mixture of *Centrosema pubescens*, *Pueraria phaseoloides* or *Calopogonium mucunoides*—requires, during the first year, the closest attention to removing selectively all competing broad-leaved weeds and grasses, as otherwise the latter will quickly dominate the leguminous covers.

During this year, selective weeding is one of the most expensive and tedious operations for rubber planters. So far it has been necessary to carry out this selective weeding entirely by hand and, especially during the first six months while the ground cover is only developing, this operation represents a very heavy expenditure.

Photos: Fisons Pest Control Ltd.

Weed control round rubber seedlings with Simazine 50W

Selective weed control

Contact weedkillers are unsuitable because they tend to damage the covers and lack persistence, but simazine has been found to be ideally suited to prevent weed growth during the critical first six months in the establishment of young covers. A dosage of 7½ lb. of Simazine 50W per acre applied to the area outside the drills of cover plant seeds as soon as these are clearly marked will prevent weed growth for 12-15 weeks.

During this time the covers grow, bunch up and begin to spread. Just as the covers are beginning to spread—after 12-15 weeks —a second application of 7½ lb. is made and this will not inhibit the spread of the covers and will permit the ground to be maintained weed-free until 6-7 months from planting and the covers are established over the whole area.

Not all estates plant legumes as covers and for a variety of reasons some prefer mixed covers of selected indigenous plants. As mixed covers will require manual selective weeding in any case, there is little scope here for chemical weed control. Where a specific weed assumes local dominance, spot application of a grass killer is practicable, or where the noxious weed *Mikania scandens* is found a hormone-type herbicide can be used.

Clean planting rows

The young rubber seedlings are generally planted in rows which may or may not follow the ground contours. During the first 18-36 months these rows will be kept completely weed-free, although covers may be permitted to spread across the rows at intervals to prevent soil erosion.

In the past, planting rows have been kept weed-free by manual weeding. Manual weeding not only makes heavy demands on labour, but it also tends to damage the soil structure and, by tending to scrape away soil from the area close to the young trunks, to expose and later damage root systems. There is a widespread tendency on the part of labourers to weed outwards, scraping away topsoil, and with it the weeds, to the edges of the planted rows —in effect transplanting weeds, which then encroach back into the planted rows and into the covers between the rows.

Weed control with Simazine 50W in immature rubber planting rows

Simazine applied following clean weeding has been found to be a most suitable treatment for maintaining weed-free planting rows in immature rubber. An extensive trial programme carried out over two years has established that the maintenance of planting rows during the first year can be achieved economically by the use of three-monthly applications of Simazine 50W, alone or containing a small addition of contact herbicide.

Less frequent application can be made by using dosages which are higher than the 7½ lb. recommended. In this way, periods of weed control of up to six months can be obtained from a single application. However, more frequent applications at the lower dosages recommended have been found to be more economical in practice. Sodium chlorate has been found to be a good, economical and efficient contact additive to simazine.

Rapidly - spreading stoloniferous

grasses, *e.g. Paspalum conjugatum, Axonopus compressus, Ischaemum muticum, Panicum trigonum, Panicum nodosum, Digitaria* spp., are on occasions actively growing on the edges of the weed-free rows or in the avenues and may tend to encroach from there to the simazine-treated rows. This problem is best dealt with by spraying the edges of rows with suitable herbicides, such as sodium chlorate, aminotriazole or dalapon, separately or in a combination appropriate to the weed population.

After 18 months many estates allow covers to spread across the planting rows in immature rubber, and this, together with the increasing shade from the growing trees, reduces the weeding problem. Application of contact herbicides before fertilising, or when the vegetation in the rows becomes too dense, will normally be sufficient for maintenance.

Weed control with Simazine 50W in an oil palm nursery, showing untreated area for comparison

Crop safety

The safety margin of herbicides used in rubber must be known and must be wide and, in addition, with the persistent triazine herbicides there must be assurance that there is no build-up of chemical in the soil. With simazine it has been established that, even if mixed into the soil, young seedlings three months old and over tolerate 7½ lb. Simazine 50W per acre and that once plants are nine months old, 15 lb. is readily tolerated.

Apart from the intrinsic tolerance of rubber to simazine, the safety margin is further increased by the physical separation of the simazine-containing top 2 in. of soil from the main root system of the rubber plants, due to the insolubility of the chemical. There is no danger from leaf contamination with simazine on rubber, as simazine is not absorbed by the leaves. Recommended dosages therefore show a wide margin of safety.

An extensive programme of soil residue tests has shown that under Malayan conditions no simazine is present in the soil once visible weed control has ended. These tests were carried out by chemical soil analysis at four different soil horizons down to 12 in. and were confirmed by biological evaluation of residual activity, using highly sensitive seedlings.

The safety margins of herbicides, such as dalapon, aminotriazole and sodium chlorate, at the recommended dosages are adequate and, due to their solubility and transient effect, there is no question of a build-up in the soil.

OIL PALM

The oil palm industry in Malaya is second in agricultural importance only to rubber and has become of increasing economic value. The desire of estates for diversification has led to part of the acreage of old rubber which has been cut out being put under oil palm cultivation. Certain soils, especially in coastal districts, show a higher profitability when planted to oil palm than to rubber. The acreage has been expanding rapidly during the last three years and is now about 140,000 acres.

The weed problems in oil palm estates are very similar to those in rubber. The weed flora is common, soil conditions are similar, climatic conditions are constant and the same chemicals can largely be used in both crops.

In young areas

The use of contact weedkillers in immature palms may result in damage

Weed control with Simazine 50W in the drip circle of an oil palm

and the practice is generally to hand weed these areas. Where contact herbicides are used in young plants the plants are protected with a shield carried from plant to plant. However, immature oil palms have been found to tolerate quite high dosages of simazine and even basket seedlings can tolerate up to 60 lb. Simazine 50W per acre. Simazine, therefore, is the exception among available herbicides in that it can be used safely at any stage of growth of oil palm.

In areas where it is intended to establish a pure leguminous cover, simazine can be used, as in rubber, to treat the areas outside the drills immediately after they are visible above the ground and then 12 weeks later to re-treat the area immediately prior to the spraying of the plants and in this way to achieve effective prevention of weed growth for the critical and costly first six months.

Circle weeding

The palms themselves are circle weeded throughout their life—in the immature stage to eliminate weed competition for nutrients and moisture; whilst in mature palms it is essential to prevent fruit being lost at the time of harvesting. Simazine is the ideal chemical for the prevention of weed growth in the circles, in immature palms as well as in mature areas. The recommended treatment for immature palms is to spray 7½ lb. Simazine 50W per acre on to the clean-weeded circles to give weed control for 12-15 weeks. In mature palms, sodium chlorate, aminotriazole or dalapon, depending on the weed flora present, may be added to the spray suspension so as to obviate hand weeding before spraying.

Weeding in nurseries

The normal practice in oil palm cultivation of keeping seedlings in the nursery for some months necessitates, in big planting programmes, very extensive nurseries. Regular hand weeding of nurseries has been required to prevent competition with the crop and this has been one of the most costly maintenance operations. Mulching may be practised to control weeds, but where it is not, simazine, in view of the high tolerance of even young oil palm seedlings to the chemical, has presented estates with a perfect answer to this problem and considerable economies can be made through its use.

PINEAPPLE

Before World War II the pineapple industry in Malaya was of major importance and the export of its crop met the bulk of the demand of the U.K. market. Neglect during the war and the capture of the U.K. markets by other growing areas has placed the industry in a weak and vulnerable position. It is only during the recent past that the industry has taken serious steps to re-enter world competition by rationalising and improving methods of cultivation and handling. The recently established Pineapple Experimental Station and the growing support of the industry are helping in this essential programme of technological improvement.

At present, weeding in pineapple is still carried out exclusively by hand. During the past two years work has been done at the Experimental Station with the newer herbicides, and simazine and monuron have been found to be successful at similar rates to those used in other pineapple-growing areas. Pineapple is resistant to application rates of 40 lb. Simazine 50W and over, which provides a substantial safety margin with a recommended dosage of 5 lb. to give weed control for 12 weeks.

As yet the establishment of regular chemical weed control programmes in the pineapple industry in Malaya is still some way in the future and its development depends to some extent on the improvements made in the organisation of the industry. However, the chemicals are available and sound weed control programmes based on them should be of great assistance in the rehabilitation of the industry.

FUTURE DEVELOPMENTS

The important Malayan plantation industries will rely increasingly on the planned use of modern herbicides. Estates will have to adjust their practices to the new herbicides, personnel will have to be re-trained and more specialised knowledge on weed control will be needed among the supervisory staff.

Training programmes aimed especially at ensuring the correct selection, calibration, maintenance and use of spraying equipment will be needed. It will be necessary also to train certain supervisors in the identification of weeds to ensure that only the right herbicides or mixtures will be used for particular areas on estates. Programmes to suit individual operations on each estate will have to be developed. This can be effected by adjusting dosage and application rates to suit individual conditions, so obtaining the maximum benefit from these newer, safer, more efficient, but more expensive chemicals.

Further field research with yet more recent herbicides which are still in the experimental stage, such as the quaternary dipyridylium compounds (paraquat, diquat), and such triazines as atratone, prometone and prometryne, may further refine and extend the field of use of the products of research from the chemical industry to the benefit of the industries concerned.

Fertilisers and Food

FAO have announced that the first two-year phase of the programme to expand and improve fertiliser usage has begun. The fertiliser industry, which is financing the programme, has to date contributed or pledged $262,300 towards the first year's work. It has already been agreed that the industry will contribute $350,000 in the first year and $450,000 in the second; further support will be given during the following three years if the programme develops satisfactorily.

Dr. F. W. Parker, Assistant Director-General of FAO, has announced that contributions to date have come from the Centre d'Etude de L'Azote, the Foundation for International Potash Research, the Institut International de la Potasse, the International Superphosphate Manufacturers' Association, the Japan Ammonium Sulphate Export Co., the Nitrogen and Phosphate Manufacturers in North America, the Shell International Chemical Co. and the Sulphur Institute.

The purpose of the programme is to stimulate the interest of governments and farmers of less developed countries in the efficient use of fertilisers and to provide governments with the advice and information necessary for developing their fertiliser programmes. This is to be effected by means of fertiliser trials and demonstrations and by setting up soil-testing laboratories and services.

Land Won from the Sea

2—Progress of the Scheme

SIR E. JOHN RUSSELL, F.R.S.

This completes the account of the reclamation of the Zuyder Zee. Not only will Holland gain from this remarkable achievement, but the whole world can learn from it.

I RETURNED to the North-Eastern Polder in July 1960, 10 years after the visit described in Part 1. Colonisation was now practically complete with some 30,000 inhabitants. The villages had not filled up as much as had been expected for a very interesting reason.

Arable crops are specially needed and all land that can produce them is expected to do so. When the plans were originally drawn up, it was estimated that eight to 10 agricultural workers would be required per 100 arable acres, and housing provision was planned accordingly (Fig. 6). In the meantime, however, farm mechanisation had made such great progress that four workers now suffice.* Even a 30-acre farmer may have a tractor, which he may hire out at times.

There had been very keen competition for the farm holdings as soon as they became available. No fewer than 3,000 applications for the first 150 had been received.

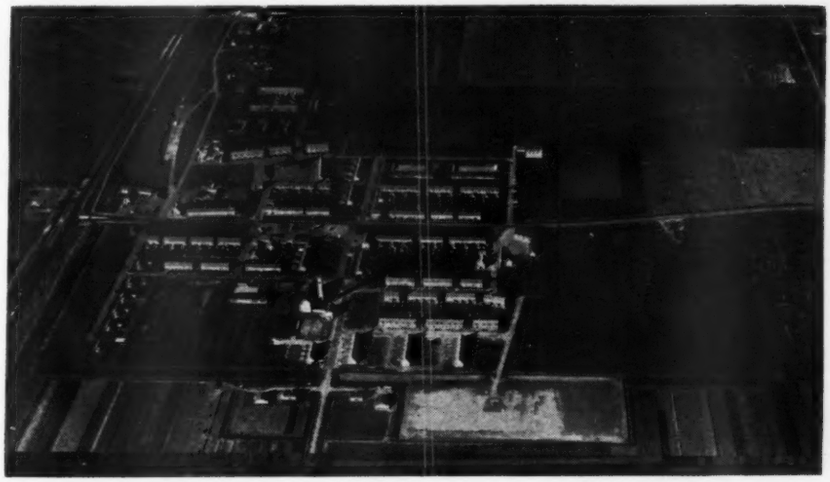


Fig. 6. North-Eastern Polder: Ens, one of 10 villages suitably spaced on or near the circular road

Method of settlement

The farms are not usually sold, but are leased from the Government. The leases run for 12 years, but are renewable if the farm has been properly managed; rents, however, may be revised every three years. Applicants must be married, between 25 and 50 years of age, and have adequate technical qualifications and financial resources.

The rents asked are high: in 1959 they ranged from £8 per acre for sandy or peaty soils to £16 per acre for loams and clays. In addition, the applicant must provide the working capital or show that he can borrow whatever part of it he lacks. The sum specified is £64 per acre, but only 25% of this need be his own money; he may borrow 50%, and when this is done the Co-operative Farmers' Banks will advance the remainder.

Personal qualifications are important in building up a new community: the selecting authority has in mind the social, cultural and spiritual needs of the population, and also aims at a proper balance in regard to age, religion and province or origin of its members. In actual fact the population is younger than the national average, the majority being between 25 and 45 years of age; the birth rate is double the national average, and more than a fifth of the total population consists of children of school age.

Special consideration was given immediately after the war to a limited number of men who had rendered great service in reconstruction, or who had been displaced by the merging of very small uneconomic farms (about 12 acres), but the chief criterion has been the candidate's own eligibility.

Forces of reaction

Not all smallholders want to acquire one of these holdings, however. On the way out from Amsterdam we had passed through a district where some of the farms were of 12½ acres only, all under grass and producing only milk. The people were poor and backward, but for various reasons—social, political or religious—were unwilling to move into the new polders even if they were accepted. They constitute at present an unsolved problem.

Size of holdings

The total area of this North-Eastern Polder is 120,000 acres and the land utilisation is shown in Table 1.

* In the 1930s' 26 man-hours had been needed for reaping and threshing 1 acre of grain; in 1960, using a combine, 5 hours sufficed. But in 1946 one trained mechanic sufficed for every 60 farm labourers, while in 1960 one was required for every six.

Fig. 7. Arable farms near Bant on the road circling the North-Eastern Polder

Table 1

Classification	*Acres*
1,600 agricultural holdings..	101,250
250 horticultural holdings ..	4,500
Afforested and planted areas	5,500
Villages, roads, dykes, etc...	8,750
Total	120,000

Percentages of farms of the various sizes are shown in Table 2.

Table 2

Acres	30 and 45	60	75 and 105	120
Number as % of total	30	40	20	10

The 60-acre group occupy the largest area of the farmed land, about 40%, and the 30-45-acre group the smallest. The latter are run by the family, including the wife, without outside help. The Government does not desire to multiply these, as such small farms are uneconomic. A satisfactory minimum size is 45 or 50 acres. The larger farms need some hired labour, but the farmer's wife does not need to help.

Fertilising and manuring

We visited one of the 60-acre holdings, a milk farm near Ens, which is on coarse sand and sub-irrigated. As usual in such conditions, it is mainly in grass—75% of it—not permanent grass, but leys of five or six years' duration. Half the grass gets all the stable manure each year; not, however, the liquid manure, as the farmer fears grass tetany. In addition, the land gets a remarkable fertiliser dressing per acre: 11 cwt. of nitrochalk (21% N), 3¼ cwt. each of superphosphate (18% P_2O_5) and potash salts (20% K_2O).

The 15 acres of arable land received all the liquid manure, and the potatoes and sugar-beet received also a dressing of 3¼ cwt. each of superphosphate and of 40% potash salts per acre.

Milk yields

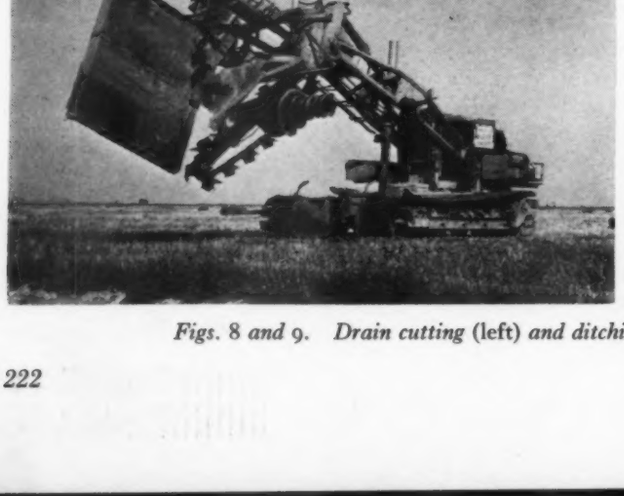
The farmer breeds Black and White Friesians (not the reds) for milk: he has about 26 in milk and averages 1,036 gal. per cow in a lactation period of 303 days; the butterfat is 4.24%. His stocking rate is 1-1½ beasts per acre, as is usual on the grass farms here. The grass was thick, very vigorous and free from weeds, although he does not use herbicides. It was grazed in strips controlled by an electrified wire. The animals were in excellent condition and very sociable [*a significant indication—Ed.*]. Some of the grass was being cut for silage.

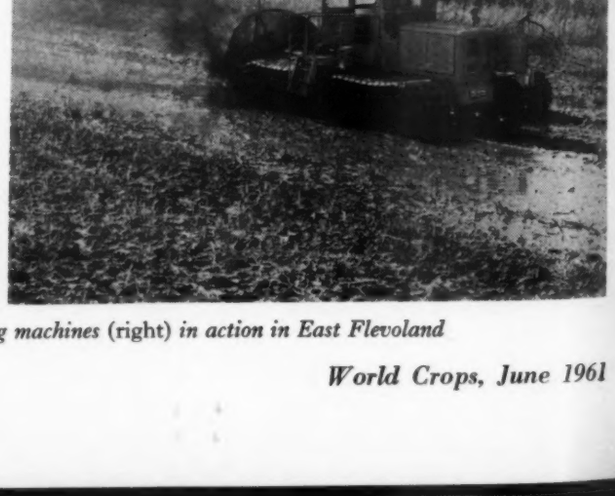
On my earlier visit I had been told that most of the farms on this polder would be in grass and the chief product milk, as on this farm. Milk yields on the polder are, in fact, high: 360 gal. per acre, compared with the national average of about 330 gal. per acre. But Holland's need for arable land is such that 60% of the farms are purely arable, the soils being loams (Fig. 7); 26% are mainly arable and only 16% are predominantly dairy farms, with more than half the land under grass.

The settlement today

When I first saw the polder in 1950 it was an enormous expanse of flat land, bare except where a beginning had been made with building. By 1960, it had a mature and well-developed look. Its chief town, Emmeloord, has grown into a spacious well-planned town of 8,000 inhabitants (though planned for 10,000), well provided with schools, churches, shops, banks and other commercial organisations, and also public buildings.

The countryside, too, has greatly changed in appearance. A well-planned and economic system of roads (see Fig. 7) makes all parts easily accessible. As on the Wieringermeer, they are being planted with poplar, willow and alder, so arranged as to avoid monotony as far as possible. Two of these have commercial value: poplar can be used for making matches and willow for making the wooden shoes which are still popular with the Hollanders; the alder as yet has no





Figs. 8 and 9. Drain cutting (left) *and ditching machines* (right) *in action in East Flevoland*

prospective use. Their value at present, however, and for years to come lies in their adornment of the landscape and in the shade they give to the traveller.

The attractiveness of the area is enhanced by the farmhouses pleasingly designed, usually on traditional lines, their red roofs appearing in a green background made by the shrubs and trees planted around them. The setting will improve in attractiveness as the years go by. But it is not all modern. We passed the ancient church of Schokland, all that remains of a little island now incorporated in the polder and appearing as a little hill. We ended our drive at the ancient fishing village of Urk, another small island that has similarly been incorporated in the polder.

In Eastern Flevoland

The third polder to be reclaimed is the Eastern Flevoland, named after Lake Flevo, which the Romans found here before the Zuyder Zee was formed. It is the largest of the three —133,000 acres in extent—and the results of the soil survey suggest that it may be the most fertile. I first visited the site in 1950: there was the beginning of a dyke, but no more, and in looking over that vast expanse of water it was hard to realise that all, as far as the eye could see, would in a few years' time be dry land inhabited by some thousands of people busily engaged on their daily tasks.

Drying-out operations

By September 1956 the 56 miles of dyke were completed, and nine months later—in June 1957—the water had been pumped out. The muddy surface thus exposed was less tractable than on the earlier polders, for about half the area has a heavy clay soil, and this not only made difficulties at the time of reclamation, but it will cause trouble as time goes on. As clay dries it shrinks and the drying process may take years.

The land on which roads, bridges and houses are now being built may before long have subsided as much as 2 or 3 ft., and this makes the work of construction very difficult. Another property of the clay may for a time in certain circumstances bring to the surface each day a layer of water about ½ or 1 in. in depth which will interfere with the drainage of the soil and delay its reconstitution.

Weed control

As in earlier reclamations, abundant crops of weeds began to appear as soon as the surface had dried sufficiently. Cultivation to kill them was quite impracticable; instead seeds of the common reed, *Phragmites communis*, were sown by helicopter and when I saw them they had produced a dense smother crop about 5 ft. high. These reeds are cut annually and burned. Export to Germany is possible, but apparently not worth while. They are to be left until the land is firm enough for drainage.

needed at the old level of labour requirement per 100 acres had proved somewhat too much, it was decided to have six villages only in spite of the larger size of the polder. Better transport facilities were, however, arranged. The chief town, Lelystad, named after the original designer of the whole scheme, was to be larger and was planned for 20,000 to 30,000 inhabitants. It is built on the lake shore and is provided with locks and wharves.

I revisited this polder in late July 1960, two years after the water had been removed and the polder left as a vast stretch of very sticky mud (Fig. 9).

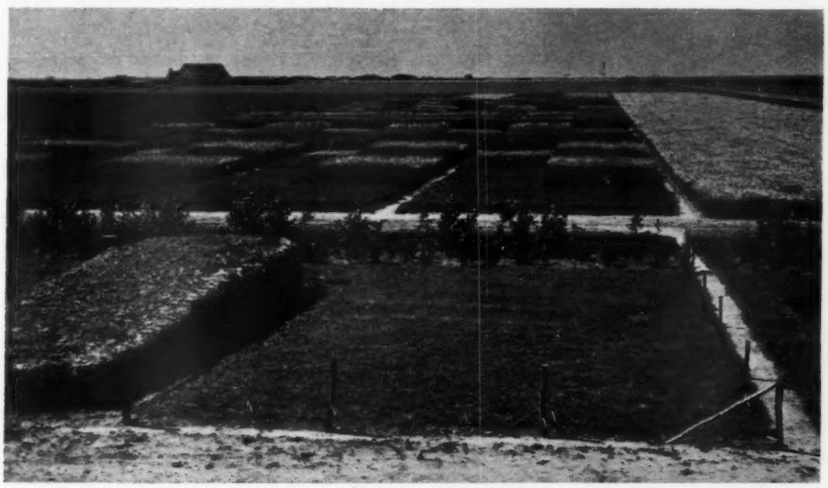


Fig. 10. A block of trial plots in the North-Eastern Polder. Scientific control has always been a feature of the whole enterprise

Drainage and ditching

The method of drainage is in principle similar to that of the other polders: open ditches for a period, then clay pipes closed in. Owing to the large area of clay soil, there were important differences in detail. Some 25,000 miles of trenches were needed, which, of course, had to be dug by machine, but as the most suitable weighed nearly 12 tons it had to be of special design to prevent it sinking into the clay. The design was successfully implemented: the pressure of the machine on the soil per square inch was said to be only one-half of that exerted by the human foot, for which reason it got named 'the lady with the outsize feet' (Fig. 8).

The widespread increase in mechanisation affected also the plan of the polder. Learning from the experience with the North-Eastern Polder, where the 10 villages that would have been

Already an army of labourers was at work; a firm road system was being made, part of which had already been completed. A big grain-drying plant had been installed, farmhouses and farm buildings were going up; prefabricated buildings were being used as before, but on an increasing scale.

Experiment station

The experimental field (Fig. 10) contained a number of variety trials. Cereals are to play an important part in the agriculture because of the ease with which their cultivation can be mechanised; stiffness of straw and winter hardiness are, of course, absolutely essential. The land was being farmed in large blocks by Government agronomists, its first crop being winter rape (Fig. 11), followed by winter wheat, then barley, and in the fourth year lucerne. The land will then be ready for settlement.

Fig. 11. Left: *Rape being harvested and threshed by a combine harvester in East Flevoland* *Fig.* 12. Right: *Land improvement by breaking the heavy clay in East Flevoland.*

New method of settlement

It is intended that each year some 10,000 acres should become available for leasing. There will ultimately be 2,000 farms and they will be of four sizes—30, 60, 90 and 120 acres—the small ones on the good light soils and the large ones on the heavy clay (Fig. 12). Purchase will be possible, but will not be encouraged, for, as on the older polders, leasing is preferred. The rents will range from £6 per acre for sandy soils, mainly grass, to £20 per acre for good clays, mainly arable. There seemed no possibility for growth or extension—if a man starts on the 60-acre scale he is liable to remain in that class.

In addition to the 110,000 acres of farm land projected, it is intended to have 6,200 acres of fruit, since apples and pears both do well. Some 5,000 acres of sandy soil too light for agriculture are to be afforested in addition to about 750 acres on better soil for recreation or social amenities. Willow, poplar and alder will be grown, as on the other polders. An expanse of water on the east side is for recreation.

Projected operations

Work is expected to finish about 1967 and the 1,000 workers will then be transferred to the Southern Flevoland polder of 150,000 acres and afterwards to the last section, the Markenwaard polder of 150,000 acres.

By the turn of the century the Hollanders hope to have gained some 550,000 acres of land and a freshwater lake of more than 300,000 acres. The cost will have been high; on the North-Eastern Polder it was £380 per acre without any buildings, but as a Minister of Agriculture explained to me, it is much less than the cost of a war of conquest, besides being far more rewarding.

The need is great

Holland's need of new land is great: its population of about 11½ million is increasing at the rate of about 1½% every year and urban developments are swallowing up some 75,000 acres of agricultural land annually. Counteraction is therefore imperative.

Coconut Research in Trinidad

A new Coconut Research Station has been instituted at Champs Fleurs, Trinidad, West Indies. It is to be administered by the Directors of Trinidad and Tobago Coconut Research Ltd., which is a non-profit-making company, financed jointly by West Indian Oil Industries Ltd., Trinidad Manufacturing and Refining Co. Ltd. and the Coconut Growers' Association.

The station, according to a recent issue of *Nature*, will be concerned with all problems of the cultivation of coconuts, with the object of increasing copra production at a lower cost. It is hoped to study the insect pests of coconuts, with special reference to their roles as vectors of red ring disease, and particular attention will be paid to the coconut palm weevil, *Rhyncophorus palmarum*, and finding means for controlling it.

The nutrition of palms will be investigated, again in relation to red ring, but it is hoped that the work will help in framing recommendations for the manuring of coconuts.

Up-to-date summaries of literature on any coconut problems which are causing concern in different parts of the territory will be circulated and so keep the planting community informed of the results of research.

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Kenaf Growing in Thailand

E. W. VAN HEURN

The economy of Thailand principally depends on exports of her agricultural products, such as rice, rubber, oilseeds and other upland crops. Among the fibre crops, kenaf is assuming growing importance.

THE Korat Plateau in North-East Thailand supplies the bulk of the kenaf fibre produced in this country; the planted area was about 50,000 acres in 1958. Most of the upland soils, mainly sandy loam, are poor in plant nutrients, but have proved to be suitable for this crop. The prevailing monsoon climate has a dry and a wet season; the latter starts in May and ends in October. The average annual rainfall is approximately 50 in.

Kenaf—the plant

Kenaf, *Hibiscus cannabinus*, produces a lignified fibre in the bast layers which is very similar to jute, *Corchorus* sp. The kenaf grown in North-East Thailand is mostly of the so-called 'Chinese variety', which is a photosensitive strain.

The plant has large pale yellow flowers with a purple centre and is generally self-pollinating. However, cross-pollination also occurs and this feature provides scope for hybridisation, and some breeding work has already been done in Java and Cuba. The stalks have a green, red or purple colour, depending on the variety, and if planted closely they rarely branch. Differences in the shape of the leaves frequently occur, even on the same plant. Under favourable conditions of soil and climate the plant can grow to a height of about 13 ft.

Its cultivation

The best yields are obtained from plantings in May and June and the crop is harvested in October. The plants are cut approximately after 120-150 days, when they commence to flower. For seed production at least 165 days must be allowed.

The usual method of sowing is by broadcasting the seed in a shallow-ploughed and harrowed topsoil at the rate of 18-25 lb. of seed per acre. Probably because of higher labour requirements, planting in rows with proper spacing between plants is seldom seen, though this method could save much seed. In the early stages one hoeing is given; after that the crop needs little attention, for once the crop covers the ground the growth of weeds is reduced. Pests and diseases are as yet not serious and do not require attention.

A thriving kenaf crop 118 days old. Huey Ban Yang, Province Nakornrajsima

Harvesting and retting

The harvesting and retting of the crop requires a considerable amount

Left: *An excellent retting place in a small river, Huey Ban Yang, Province Nakornrajsima.* Right: *Retting kenaf in a roadside canal, Province Udorndhany*

After retting the fibre is stripped from the stems. Huey Ban Yang, Province Nakornrajsima

of labour, since every operation is done by hand. The stalks are cut and bound together in handy bundles and are then kept in the field for about a week to allow the leaves to fall. A portion of the tops is cut off and then the bundles of stalk are soaked in water for approximately two weeks. When this retting process is finished the fibre is stripped from the stems and washed to remove dirt. It is dried in the sun for about four days and packed in bales in 100-kg. lots for marketing.

The retting is done in small ponds or deepened rice fields and streams and canals beside the roads are also used. The best qualities of fibre are obtained where clean water is in ample supply. At the beginning of the dry season this may present a problem. The best facilities are to be found near a tank* irrigation project, of which there are about 120 scattered over the region, with storage capacities mostly varying between 3 and 6 million cu. m. of water. Mechanical decortication might be the answer to the difficulties of water supply.

Yields

The yield differs considerably from place to place and varies between 600 and 1,800 lb. per acre. Experiments, however, have given yields of 2,300 lb. per acre when the crop is grown under proper methods of cultivation. The seed yield is approximately 900 lb. per acre.

Production and Marketing

About 1950, when the world price for kenaf rose, production increased rapidly. While in 1945 production was insignificant, total production in 1951 was 20,000 tons. In 1954 the production declined owing to decreasing market price, but from 1955 onwards there was a steady increase.

* Tank: an irrigation reservoir.

Table 1

Kenaf Production in Thailand 1950-1959[1]

Year	*Area planted* (1,000 *acres*)	*Production* (1,000 *tons*)	*Market value* (*millions of baht*[2])
1950 ..	12.71	4.7	9.0
1951 ..	36.08	20.0	35.0
1952 ..	27.47	13.1	10.6
1953 ..	24.60	14.0	11.1
1954 ..	15.17	8.2	10.6
1955 ..	21.73	9.8	14.7
1956 ..	44.69	17.0	27.2
1957 ..	31.98	21.0	30.4
1958 ..	52.07	29.6	36.1
1959 ..	71.18	39.95	n.a.

[1]Agriculture Statistics of Thailand, 1958, Bangkok, Thailand. The figure of 1959 is an estimate.

[2]£1 sterling = 58.8 bhat (Thai currency).

Sun-dried kenaf fibre. Huey Ban Yang, Province Nakornrajsima

Most of the kenaf produced is shipped to foreign markets, such as the U.K., Belgium, Germany and Japan. Rice and sugar bags are made from kenaf fibre in three mills in the country, which produce about a third of the annual domestic requirements of about 15 million bags.

Acknowledgment

This study was made when the author was attached to the Royal Irrigation Department as Irrigation Agronomist, and he acknowledges with thanks the facilities provided by the Director-General.

Kenaf fibre packed in bales ready for transport, Ban Phai, Province Kon Kean

A field of young tobacco in West Australia. In the background can be seen the kilns and curing sheds

Australian Tobacco

L. T. SARDONE

The 'pernicious weed', Nicotiana tabacum, *originally native to America, is now cultivated in many tropical and semi-tropical countries for smoking, chewing and, to a lesser extent, for use as snuff and as an ingredient of certain insecticides.*

AS an import-saving crop, tobacco is assuming increasing importance in the Australian economy. The first commercial venture began on New South Wales prison farms in the early 19th century, the total crop in 1826 being around 50,000 lb. The primary importance of this crop in those far-off days was to provide an invaluable ingredient of sheep dips.

The fortunes of the industry have fluctuated over the years. In the early 1930s acreage rose from 2,500 to more than 20,000 because of a high import duty on tobacco. Disease, low yields and poor quality leaf, due to unsatisfactory curing methods, caused a drop in output in the next 10 years to about 4 million lb. from 3,000 acres.

In the early 1950s extensive Government help was given in the form of research, advisory services and subsidies for irrigation. Substantial tariff rebates were also made to manufacturers who used a certain proportion of Australian leaf in their blended tobaccos.

Geographical distribution

The principal tobacco-growing areas are in Queensland, where about half of the total of 21,000 acres was planted in 1960. The northern centres of Mareeba and Dimbula are the main Queensland tobacco-growing regions and the chief area in New South Wales is on the Queensland border. New South Wales and Western Australia each have about 2,000 acres under tobacco and Victoria about 7,000 acres.

Australian average yield has risen from 540 lb./acre in 1956 to 904 lb. in 1960. Oversea yields in the leading tobacco-growing countries are usually 1,500-2,000 lb./acre.

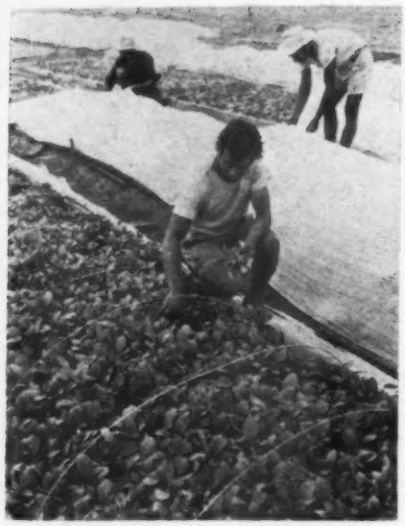
Varieties planted

In Queensland 'Gold Dollar', 'Kelly 402' and 'Virginia Gold' have generally given good results on the lighter soils, ranging from sandy loam to loam. On heavier soils the varieties 'Hicks' and 'Yellow Special' give a heavy yield of bright leaf, provided care is taken to avoid the use of too much nitrogenous fertiliser. "Hicks', 'Virginia Gold' and 'Kelly 402' are at present the three varieties in greatest demand. They yield well and produce the bright types of leaf which are at present in demand.

Nursery operations

The production of vigorous, well-developed seedlings is essential for maximum yields. Seedbeds are used and in the past it has been the practice to provide 100 sq. ft. of seedbed per acre of field. On irrigated farms, however, seedlings can be transplanted as soon as they are ready, the seedbed area thus being reduced, two beds, each 10 ft. x 4 ft., are sufficient for each planted acre.

Soil sterilisation is carried out to destroy nematodes, grass and weed seeds, insects and any diseased plant tissue which may be in the surface soil. This is usually done by heat, by burning light bush timber and anthill material.



Tobacco seedlings being culled prior to transplanting. The plastic covers prevent sun scorching and the ingress of foliage pests

When fertilising the seedbeds care is taken not to use too much nitrogen in any of its organic forms—dried blood, cottonseed meal or animal manures—otherwise yellow patch is likely to develop, with disastrous results. Nitrate of soda is mainly used as the source of nitrogen. Superphosphate supplies the phosphoric acid, while sufficient potash will normally have been incorporated with the wood ashes.

Sowing

Tobacco seed is very minute, about 12 level teaspoons being equal to 1 oz. Care is taken not to sow the seed too thickly, as this results in weak, spindly seedlings prone to disease. Just under half a level teaspoon of seed is sufficient for a standard seedbed of 40 sq. ft., so it is important to dilute the seed with sand to ensure even distribution.

On irrigated farms, seedbeds are sown from mid-July to mid-September, the seedlings used being about six weeks old and 4-8 in. high when ready for transplanting.

Irrigation and cultivation

Availability of water during growth is most important and it is futile to attempt to grow a greater area than the water supply will allow. Both spray and furrow irrigation is used. A third method of partial irrigation—watering-out—has sometimes to be adopted where the water supply is insufficient for complete irrigation.

With furrow irrigation, the best gradient for most soils is 2 in. to the chain, with rows not more than 5 chains long. After each irrigation cultivation is necessary to aerate the soil, eradicate weed growth and permit better moisture penetration at the next application. On average 12-18 in. of water are necessary to grow a crop with weekly irrigation.

Spray irrigation or artificial rain is usually applied where the land is too uneven or too sloping for effective flood irrigation.

With watering out, water is applied by hose from a tank to each permanent plant position on the hill formed after fertiliser application. Tanks carried on flat-top wagons are drawn down the rows by tractor or horses. In periods of prolonged dry weather crops have been watered by this method until the plants are too high for the wagon to pass over them without damage.

Young tobacco being cultivated; they reach maturity about 10 weeks after transplanting

Tobacco diseases

Whilst a number of disorders, both parasitic and non-parasitic, have been recorded on Australian tobacco, it is fortunate that relatively few have proved sufficiently serious to be important factors in production. The principal diseases are blue mould, mosaic, frog-eye leaf spot, damping off and stem rots.

Blue mould, the greatest scourge, is a fungus disease of the downy mildew type, which can attack tobacco at any stage from the recently germinated seedling to the mature plant ready for harvest.

In the seedbed the first indication is when patches of seedlings lose their normal green colour and become yellowish-green. The upper leaves lose their rigidity and droop, while the lower leaves develop yellowish areas on the under-surface, on which a typical grey or purplish down will be found.

In a severely damaged plant the fungus penetrates to the internal tissues of the midrib, and from there into the stem. With a field exposed to a bad attack soon after planting out the internal stem symptoms quickly develop, growth rate of the worst affected plants is considerably reduced and much unevenness in the stand results.

Since it is possible for blue mould fungus to over-winter on volunteer* plants and in crop residues, strict attention is paid to field hygiene. Stalks are removed and destroyed and their removal is accompanied by deep ploughing to dispose of leaf remains. Additionally, tobacco is grown in rotation with other suitable crops, such as cow peas, velvet beans or groundnuts.

A similar precaution is taken with the seedbeds, the sites of which are shifted each year; the soil used is sterilised by heat or by chemical means.

Control of seedbed blue mould is effected by overnight treatment with

* Volunteer: of vegetation, self-planted.

The leaf is finally harvested about three months from the time of seeding. Here the leaves are being strung on sticks for curing

benzol vapour under a vapour-tight cover. This treatment is commenced immediately after seed germination and is not delayed longer than 10-14 days.

Treatment of field blue mould with fungicides poses difficult problems. Preventive spraying with zineb at weekly intervals calls for rapid and efficient coverage of both top and bottom leaf surfaces of new foliage, not easy to ensure because of the rate of growth. Furthermore, spraying becomes progressively more difficult as the plants age.

Of major importance was the discovery by a New South Wales agronomist of two new strains of tobacco highly resistant to the disease. For the past two years these have been on trial in this state. They are also being tested in Western Australia, and also by the Commonwealth Scientific and Industrial Research Organisation. This discovery has been received as one of the most significant within the past decade in Australian tobacco culture.

Mosaic is a widely distributed virus disease with the dubious distinction of being the most infectious plant virus in existence. The characteristic symptom is a light green and dark green pattern on affected foliage. Mosaic disease is responsible for considerable loss through yield reduction and depreciation in leaf quality.

Control comes with strict seedbed hygiene, heat sterilisation of soil, freedom of seed from chaff and dust, and the elimination of all weed growth.

Frog-eye leaf spot is fungus-caused, but, being favoured by high temperatures, is a disease mainly of tropical areas. Thus in Queensland it is of importance only in the north, and then only on late crops which reach maturity during the hot weather.

Spots first show on the lower leaves and when plentiful are small, roughly circular, brown areas, the centres of which bleach as they age to give the typical frog-eye appearance of a dark brown ring with a light brown or grey centre.

The disease can be carried on the seed and when it is not known whether seed is free it should be surface sterilised before sowing by immersion in a 1 : 1,000 solution of silver nitrate in water for 15 min., followed by a clean water rinse.

Care is taken to avoid contamination of seedbeds by diseased leaves from barns, bulk sheds or fields, and so all plant refuse is burned. Seedbeds are sprayed thoroughly and often (at five-day intervals) with home-made cuprous oxide or Bordeaux mixture.

Damping off is a seedling disease caused by fungi living in the soil the first indication being the collapse of a patch of plants. Stems at ground level soften, discolour and constrict so that the roots rot. Tender seedlings are more prone to the disease.

Seedbed crowding predisposes plants to attack, so that care has to be taken to sow only at the recommended rate. Over-watering is avoided and seedbeds are changed regularly, for the repeated use of the same seedbed leads to a build-up in the number of damping-off fungi present.

The dried leaf being baled for marketing. After curing it is hung for eight days before being graded into one of 22 grades

If damping off appears in a seedbed, drenching with thiram or captan, depending on the type of damping off present, is used. Thiram drench with 1 oz. of 80% thiram in 4 gal. of water will control damping off of the type in which the root is shrivelled and rotted. If the seedlings are rotted at ground level, with the root remaining healthy, then a drench with 1¼ oz. of 50% captan in 4 gal. of water will give better control. Drenches are applied at the rate of ½ to 1 gal/sq. yd. of seedbed.

Two types of *stem rot* often cause losses in the tobacco fields. The most commonly observed attacks plants at or below ground level and gives rise

Photos: Australian News and Inf. Bureau

High-quality tobacco leaf produced on a farm at Mareeba on the Atherton Tableland, North Queensland

to a dark brown or black sunken area at the stalk base. When the disease is in an advanced stage, the pith of the lower part of the stem will have rotted completely and brown fungus threads are to be found in the hollow cavity.

The second rot is caused by a fungus which is one of the most widely distributed plant pathogens in Queensland. It affects the same stem region as the other type. Infection originates at or below ground level, but the damaged stem area is lighter brown, is restricted more to the basal portion of the stem and very quickly becomes covered with the cottony wefts of the fungus.

A feature of both stem rots is that the stalk tissues may become weakened by the fungus invasion, and if strong winds are experienced, infected plants may be blown over rather easily before they show signs of wilt.

If damping off has occurred in a bed, any seedlings taken from that bed in the vicinity of the patch showing disease symptoms are carefully inspected and all suspicious plants are removed.

With the first stem rot the fact that the fungus can invade wounds on leaf stalks and stems suggests that early priming of the sand lugs to allow the scars to harden before hilling commences may be of some benefit on land which has a history of such infection.

Stem rots occur most on land which has been planted to tobacco for two consecutive seasons. Rotational planting should therefore be practised.

Tobacco pests

It is found that endrin applied at 3-6 oz. per acre by low-volume spraying will effectively control *tobacco looper*, *cluster caterpillar*, *stem borer*, *leaf miner* and any minor foliage insects, such as *thrips* and *jassids*, which are sometimes associated with the tobacco crop. It has been recommended that a combined spray of endrin and DDT should be used weekly for the first three weeks after transplanting. Specifically for the control of leaf miner a spray containing 0.05% 'Telodrin' has been suggested.

Aldrin may be used for the protection of the seedlings against *wireworm* attack. This may be applied as a dilute emulsion in the irrigating water or as a soil treatment to be followed by light cultivation to a depth of 6 in. prior to transplanting.

Root knot or *club root nematodes* are microscopic worms which are to be found in the roots of some tobacco plants. They cause malformations and swellings and this pest will deprive the host plants of some of their food material. As a direct result the foliage of the affected plants will be reduced and they may eventually die.

Before the advent of chemical control the only way of minimising the extent of the attack was by rotation with nematode-resistant crops. Now the usual methods of field hygiene (as previously outlined) are followed and the more progressive farmers use a solution of ethylene dibromide (EDB) as a soil fumigant, injected on either side of the row to be planted.

Harvesting

Harvesting is avoided during hot weather and on wet and cloudy days, as this causes thin, black trashy leaf. Harvested leaf must be treated very carefully to avoid tearing or bruising when being taken to the stringing sheds.

Here pre-treatment prior to curing is carried out in three stages: colouring the leaf, fixing the colour, and drying out the midrib. In the first stage the colour of the leaf changes to a yellow or light pea green. The fixing process eliminates all green from the leaf, fixes the colour desired and partly dries the leaf. The third stage completes the drying out of the midrib.

Curing, grading and marketing

With kiln or barn curing a recent advance in heating is the use of kerosene and dieseline instead of wood, saving both time and labour. After curing, the leaf is carefully graded into one of 22 grades, then bulked down in bales ready for auction. The recognised colour grades are lemon, bright mahogany, mahogany, dark and green.

Australian tobacco is mostly sold by public auction and competition for the better leaf has raised the average price in 1960 to more than double the duty-free price of imported American and Rhodesian tobaccos.

Coming Events

Grassland Research.—The Grassland Research Institute at Hurley will hold its Open Days this year on 27 and 28 June. Members of the public are invited to attend and may obtain further details from the Institute, Hurley, nr. Maidenhead, Berkshire, England.

Packaging.—An International Packaging Exhibition will be held in Milan, Italy, from 20-29 June. Details from the International Packaging Exhibition (IPACK), Via Lanzoni 4, Milan.

Pest Control.—The British Weed Control Council, in conjunction with the Pesticides Group of the Society of Chemical Industry, have arranged a one-day Symposium on Industrial Weed Control, which is to take place on 30 June at the Royal Commonwealth Society. Applications to W. F. P. Bishop, 52 Bedford Row, London, W.C.1.

Tropical Agriculture.—A Preparatory Course in Tropical Agriculture has been arranged by the Oxford University Committee for Commonwealth Studies from 3-15 July. There will be no charge for the course other than for accommodation in Oxford. Enquiries should be addressed to Mr. G. B. Masefield, Department of Agriculture, Parks Road, Oxford.

The U.K. Branch of the Imperial College of Tropical Agriculture Association will hold an open meeting in London on Friday, July 21. Details from Mr. E. G. Wright, 28 Highfield Drive, West Wickham, Kent.

Russian Trade and Industry.—The Soviet Exhibition to be held at Earl's Court, London, from 7-29 July will present a picture of Russian life, culture, work and achievements in economy, science, technology and agriculture. A particularly large section of the Exhibition will be devoted to agriculture. Further information may be obtained from Industrial and Trade Fairs Ltd., Commonwealth House, New Oxford Street, London, W.C.1.

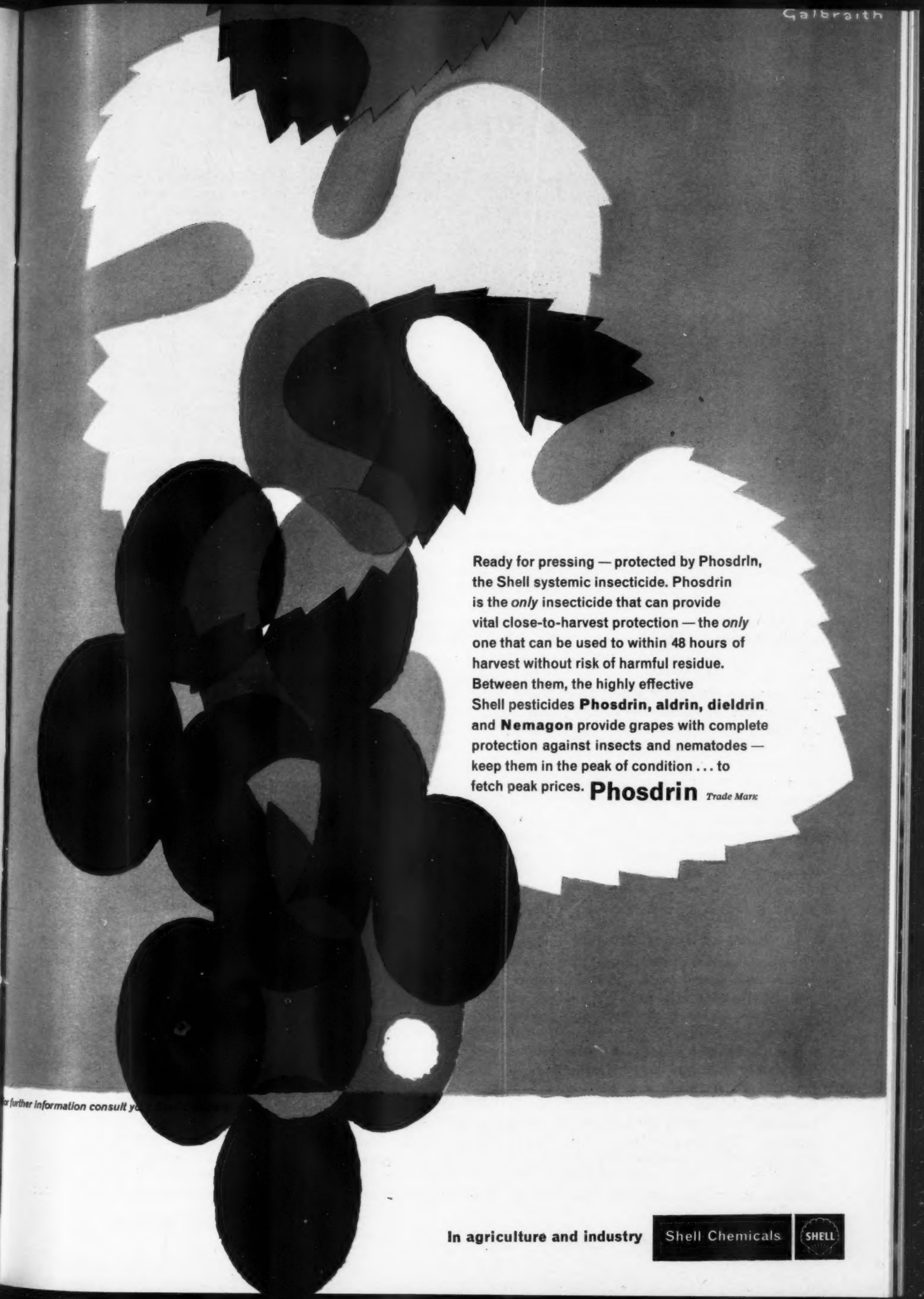
Agricultural Economics Extension.—The Ninth International Training Centre on Methods and Programme Planning in Agricultural and Home Economics Extension will take place at Wageningen, The Netherlands, from 12 July-6 August. Details may be obtained from the Director, International Agricultural Centre, 1 Generaal Foulkesweg, Wageningen, The Netherlands.

Irrigation.—An International Course on Irrigation in Sub-tropical Regions will be held at Emek-Hefer, Israel, for six weeks from 1 August. Particulars from: Irrigation Extension Centre, Post HaMidrasha LeHaklaut, Emek-Hefer, Israel.

Agricultural Exhibitions

England.—The Royal Show will be held this year in Cambridge from 4-9 July. Enquiries to the Secretary, Royal Agricultural Society of England, 35 Belgrave Sq., London, S.W.1.

Congo.—An International, Commercial, Industrial and Agricultural Exhibition has been planned from 8-23 July in Elizabethville. Information from the Secretary-General, Elizabethville International Fair, 2180 Avenue Leman (P.O. Box 1916), Elizabethville, Republic of Congo.



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For further information consult yo

In agriculture and industry Shell Chemicals SHELL

World News

West Nigeria

Help for Farmers

The wealth and prosperity of Western Nigeria is based on agriculture, with 60% of the male working population engaged in either farming or fishing.

Premier Akintola told farmers recently that arrangements have been completed to assist them to pay off all legitimate debts owed to money lenders through the Region's Finance Corporation.

Farmers would be given all the protection they need to keep their farms and enjoy the fruits of their labour; legislation is in preparation which will make it unlawful for a farmer to give either his farm or his crops as security for loans. Thereafter any money advanced on the security of a farm or farm products will become irrecoverable.

The Western Nigerian Government has long offered more orthodox credit facilities to farmers. During the course of the 1955-60 Five-Year Development Plan the Finance Corporation has made loans totalling nearly £2 million for major agricultural operations, crop processing, cocoa-spraying equipment and cocoa cultivation. A further allocation of £1.2 million has been made under the 1960-65 Five-Year Development Plan. This is in addition to the estimated £20 million the Government is investing in the coming years in a large co-operative farm settlement programme.

British Guiana

Grants for Agriculture

British Guiana is to benefit by £1.2 million from grants made under the Colonial Development and Welfare Act.

The largest grant is for £1.1 million to meet half the estimated cost of the Tapakuma Drainage and Irrigation Project. This scheme is to develop the Essequibo coast for agricultural purposes by enlarging the lake conservancy (Tapakuma, Capoey and Reliance) and by rehabilitating and extending the drainage and irrigation systems to provide adequate water control for about 36,000 acres, of which only 8,000 acres are at present securely irrigated. When the scheme is completed about 20,000 acres of the land will be suitable for rice, coconuts and cocoa. Coffee, citrus and other fruits could be grown on a further 6,000 acres.

Another grant is for £90,000 towards the cost of soil surveys and another contribution is to help towards the cost of training field assistants at the Eastern Caribbean Farm Institute in Trinidad.

Israel

Coffee Growing Established

Farmers in Israel will shortly be in a position to start coffee growing on a commercial basis. This is the result of experiments conducted for 12 years by Dr. Gindel, of the Agricultural Research Station at Rehovot. Sixty-five different strains were tried and seven were successfully acclimatised by special methods of irrigation and plant protection.

The experimental crop yielded 400-600 kg. of beans per acre and has now been grown for seven consecutive seasons; it was not affected by frost, weather conditions or diseases, even in poor soil.

About 4,000 coffee plants are under cultivation, 3,000 of them in experimental stations and the remainder in settlements and farms. Local instant coffee manufacturers have already ordered 200 tons for production purposes. At present coffee valued at about $2.5 million is imported annually into Israel.

It is claimed that this achievement refutes the view that rainy, tropical zones alone are suitable for coffee growing. Thus the boundaries of the coffee zone has been shifted 10° farther north.

Italy

Farm Mechanisation

It has been estimated that 11 million h.p. is being used on Italian farms by 248,000 tractors, 4,000 combine-harvesters, 94,000 motor mowers, 25,000 two-wheeled tractors, 228,000 agricultural vehicles and 25,000 other machines with a motor.

In 1960, although Italian agriculture was in economic difficulties, a record number of tractors were registered.

Chile

Rust-Resistant Lentils

Since 1957 Chilean lentil growers have been plagued by a rust disease, *Uromyces fabae*, that has caused widespread damage to lentil crops in some areas and total loss in others.

It is hoped that a new rust-resistant hybrid now being developed may help to re-establish the crop. Two rust-resistant seeds, Algeria 211, imported from Algeria, and Larissa 01, an import from Greece, have been crossed at a Chilean experimental station and enough rust-resistant seed has been produced to supply commercial producers. Algeria 211, a large seed, is less resistant to rust than the smaller Larissa 01, and to assure high yield the seed will probably be further crossed with Chilean rust-resistant seed.

U.S.A.

Fertilisers for Alfalfa

Fertiliser tests conducted by research workers at the Maryland Agricultural Experiment Station showed that yields of alfalfa from fertiliser applied in the autumn were equivalent to those obtained from spring fertilisation. In one of the tests 400 lb. per acre of an 0-20-20 fertiliser applied annually in the autumn gave a yield of 3.67 tons per acre of hay. When the same amount of fertiliser was applied in the spring the yield was 3.62 tons. In this same test the plot which received no fertiliser yielded only 2.76 tons per acre annually.

These results were for a four-year period and showed that the time of application appeared to have little effect on total yield for the season.

Dr. James R. Miller, of the Agronomy Department, recommended that 500-600 lb. per acre of 0-15-30 fertiliser containing borax should be applied annually. Fertilisers such as 0-10-20 and 0-18-36 can also be used.

Photos: Plant Protection Ltd.

Spraying sugar-beet with 'Metasystox' at 12 fl. oz. in 20 gal. water per acre. The machine in use is a Ransomes 'Cropguard' mounted on a Nuffield tractor

Making Known

Problems of Advice and Education in the Use of Herbicides *

The rapid development of chemical weed control has been one of the most remarkable of the post-war developments affecting agriculture. The people most concerned are the farmer, the manufacturer, the merchant, the field force of the National Agricultural Advisory Service and the Research Organisation of the Agricultural Research Council.

A Manufacturer's Point of View *by E. Holmes (Plant Protection Ltd.)*

The manufacturer's problem, like that of the Ministry of Agriculture and the merchant, is, basically, to ensure that the farmer is made aware of the technical and economic possibilities of the use of weedkillers—on different weeds, in different crops and under the particular conditions of his holding.

The difference is that he then tries to persuade the farmer to use his particular products. To this end, the manufacturer must have a highly skilled technical staff at his home base and a competent field force working for his sales department in regular contact with selected merchants and farmer customers.

The technical staff at the home base of a small company may consist of a few graduates, each skilled in his own particular discipline: chemistry, physics or engineering, agronomy or botany. With large companies, the organisation may be much more elaborate and consist of a research and development (R. & D.) department in addition to a separate technical service (T.S.) department.

The R. & D. department will be carrying out basic plant physiological and chemical work on herbicide problems, exploratory work on potential new herbicides, small- and large-scale screening, field evaluation and so on. This department will be contacting farmers primarily from the point of view of their unsolved or only partially solved herbicide problems and to find areas where particular weed problems may be investigated.

The T.S. department will be concerned primarily with taking new products from the R. & D. department, seeing them through their inevitable teething troubles, referring intractable problems back to R. & D., and generally helping their commercial colleagues in the office and in the field to exceed their sales forecasts. In the early days of a new product, members of this department will do a great deal of work going out with the field representatives to visit and expound the new story to merchants and farmers. As progress is made the field representatives take over more and more of this work, coming back to the

* A WORLD CROPS digest of three of the papers presented in the 5th Session at the Fifth British Weed Control Conference held in Brighton in 1960.

T.S. department only when they meet major difficulties.

Because there are some 409,000 holdings of over 5 acres in the U.K. it is obviously difficult for the staff of any company, however large, to visit a significant proportion of them. The manufacturer must, if he aims at nation-wide distribution, use the services of a great number of merchants, for with the aid of their representatives he increases his effective field force.

There are three main methods by which information and ideas may be communicated to the farmer: the printed word, word of mouth and visual aids. The whole object is to induce interest, provoke questions and lead to sales *which will be profitable to both parties*.

The manufacturer goes into print in at least five ways, *viz.*: labels, data sheets, leaflets and brochures, press articles and advertisements. The label is certainly the only document the user of a product can be assumed to have read, or at least had an opportunity of reading, before the product is used. The manufacturer must be as helpful as possible in giving the merchant and farmer as much information as practicable to enable the latter to get good results; he must protect himself by giving adequate 'do's' and 'dont's' regarding possible causes for dissatisfaction.

When, in addition, it is realised that he must include other items such as may be required by the poisons regulations and the Approvals Scheme, the label never seems big enough. Even when a real effort is made to give clear, concise and readable instructions one can never rely on them being read.

Data sheets are usually prepared to summarise information on new products and are primarily for the use of research men and sometimes for the technically interested merchant, but rarely for the farmer.

Most manufacturers therefore spend much thought and money on leaflets and elaborate brochures. The latter usually contain a large amount of carefully selected and expensively edited and printed information which some farmers find useful.

'Making known' by word of mouth covers talks, lectures and occasionally broadcasts. In my company we hold regular conferences with our technical and field staffs, with special conferences in addition when there is a new weedkiller, new technique or new machine to describe.

Similarly, we arrange frequent meetings with our agents and their representatives with the object of helping them to give the correct story to their customers.

Contractors and their staffs are met regularly and discussion ranges over machinery and techniques as much as over products.

Mainly during the winter, the technical staffs of all companies are regularly committed to delivering lectures and discussions with agricultural societies, National Farmers' Union branches, Young Farmers' Clubs and local farmer groups.

The visual aids used include films and film strips, weed charts, show exhibits, field demonstrations and farm walks.

The difficulty with films is that they must be limited to a single theme. This is suitable for a product or a new spraying technique, but it is liable to become too difficult if the theme is complicated by the introduction of variable methods for use under different conditions or in particular parts of the country.

Show exhibits are usually a mixture of films, charts, photographs, product samples and sometimes machines. The primary object is to induce interest and provoke questions.

Field demonstrations can be an enormous aid to weed-killing education. But they must be coupled with farm walks, during which the amounts and conditions of application, of what product through which machine, can be described and discussed.

In conclusion, despite all the labels and the leaflets, and all the lectures and the films, the best way to tender advice and provide education on weedkillers is to encourage progressive farmers to use new products at strategic points well distributed over the country. Then leave the other farmers to 'look over the fence'.

A Merchant's Point of View *by M. S. Bradford* (*National Association of Corn and Agricultural Merchants*)

The farmer is now offered herbicides which enable him to overcome a great number of problems of varying complexity. Problems requiring considerable precision and knowledge in the use of the chemicals concerned if they are to be used properly.

Misuse due to ignorance can result in promising materials and techniques being quite wrongly considered a waste of money. One 'eminent' failure in a district can offset the results of dozens of correct applications which did what was required of them.

The merchant, then, has a vital role in disseminating sufficient knowledge to the man who does the actual work. Basically the requirement is for the man on the tractor to apply, through an efficient mechanical sprayer, the chemical which will give the greatest return in profit to the man who bought it. This does not necessarily mean the chemical which will give the best purely technical control of the weed problem present.

Many manufacturers are beginning to find that economics are forcing them to direct their selling effort through those merchants who offer a post-sales technical service on the farm and who can thus save the vast amount of time previously spent on farms by their own technical sales force. Particularly is this so where farms are small and the potential from each individual call likewise small.

I must not leave this point without mention of the valuable and ever-increasingly efficient work of the officers of the N.A.A.S., with whom we work in close and cordial co-operation.

Next is the problem of the education of the user. Much can be done to impart basic principles by the many excellent films produced by the manufacturers, which, when shown to selected audiences, with time given for discussion, can greatly assist, particularly if the sprayer operators can be present.

It is almost impossible, and probably undesirable, to try to educate, the majority of users to a high technical standard of knowledge of herbicides. You have got to advise them, in writing, and hope the sprayer operator does not misunderstand what you have written.

A servicing scheme has been developed whereby farms are walked by appointment. A detailed written report on each field visited is sent to the farmer the following day. If a report is particularly urgent, it is made out on the spot. The report gives a synopsis of the problem presented by the field, with detailed recommendation of chemicals and the

Control of buttercup with MCPA in grassland. Centre strip was left untreated

techniques to be used where such a procedure is considered a paying proposition.

Written reports after a visit are valuable because they imply an acceptance by the merchant of a measure of responsibility for the accuracy and calibre of the advice given, and also prevent misunderstanding arising from verbal advice.

It is not realistic to try to make of every farmer-user a highly technical expert in relation to herbicides, but every effort should be made to get him to that state of mind where he realises that a little knowledge can be a dangerous thing.

The Farmers' Point of View *by G. E. Limb (National Farmers' Union)*

The introduction of these potent new tools has in no small measure been responsible for the great increase in output from our industry. *Farming is now producing nearly 70% more than pre-war in spite of a reduction in labour and land resources.* Indeed, the development of chemical weed control has been one of the most remarkable post-war developments affecting agriculture and the rapidity with which these products have been taken up by our farmers surely makes nonsense of the often repeated statement that there is a 20-year gap between research and the application of the results in agriculture.

There are now some 70 or more recognised chemicals with herbicidal properties and one chemical may sometimes be known by more than one name. Of the score or so of these in regular use in Britain, there may in some cases be as many as 50 separate brands of the same chemical, each being offered under its own distinct brand name, often bearing no connection with the name of the basic ingredient.

Just as the variety of herbicidal products available to the farmer is tremendous, so also the variety of weeds to be controlled is formidable, running into hundreds and involving problems of recognition and identification, particularly at the seedling stage. Having located a product which will control the major weeds, problems of finding the correct dilution and the best time of application in relation to both crop and weed and consideration of possible long-term effects on the crop or injury to neighbouring crops have to be taken into account, while precautions have to be considered to protect the operator when using toxic chemicals.

On the one hand we have this rapidly expanding new science in which it is not easy even for the technicians to keep abreast of new developments, while on the other hand we have a multiplicity of relatively small farmers to whom the whole process of selective weed control with growth-regulating substances and the like is, if not something unnatural, at least something very different from traditional husbandry practice.

To what extent have the rudiments of the subject been taught to the new entrants to agriculture who may be attending part - time, day - release courses, farm institutes or agricultural colleges? While it is reassuring to find there is reference to weed control in the syllabuses, the time devoted to it as a separate subject must be limited and student experience in the practical application cannot be extensive. These young people have at least had some basic training in this science and must have an advantage over established farmers who completed whatever formal technical training they had before the advent of these products and in consequence have had to pick up their knowledge of the subject largely from commercial sources.

Even for students, the multiplicity of brand names must cause confusion in their minds, as they are taught to recognise a spray by the chemical name or symbol of its active ingredient (*e.g.* CMPP), and the use of brand names is carefully avoided, whereas, when the student has to deal later with these materials it is by their brand names that they are bought and used.

A permanent series of demonstration plots at each of the institutes and colleges might be sponsored by an independent organisation, such as the British Weed Control Council, and these would serve a very useful purpose in illustrating the full scope of chemical weed control and giving young farmers an opportunity of seeing what range of products are available.

The National Farmers' Union has for many years looked on the Approved List published by the Crop Protection Products Approval Scheme as being a most valuable guide to help in sorting out the great variety of products on the market. Even greater reliance might have been placed in this list had it not been for the fact that new products could not be officially approved for some time after their introduction.

With the new Agricultural Chemicals Approval Scheme, it is to be hoped that these difficulties have been overcome and that there will be no reason why every worthwhile chemical should not be quoted in the Approved List;

indeed, once the new scheme has come into force there can be no justification for a farmer purchasing a product not approved under this scheme.

Information is needed, not only to assist in the selection of the best product for use in specified circumstances, but a major advisory problem is presented by the need to ensure their correct use to avoid unnecessary damage to neighbouring crops, birds and other livestock and also, of course, to the people who apply the chemicals and those who finally consume the crop which has been sprayed.

If all the varied circumstances of usage are to be taken into account, the volume of information must inevitably detract from the attention given to important items of detail; it is of vital importance that users are left in no doubt as to the dangers arising from the handling or application of the product. Spray drift is a problem that has been with us since selective herbicides were first introduced and the problem is by no means solved. The combined efforts of all concerned with herbicides must be directed to finding sprays less liable to drift and to ensure that the conditions under which such hazards can arise are more fully understood.

Developments in Agricultural Aviation

This is a short summary of a lecture given in April by Dr. W. E. Ripper to the Royal Aeronautical Society of Britain.

Photo: Dow Agrochemicals Ltd.

A spraying helicopter operating in difficult terrain in Norfolk, England

THE performance, operating and capital costs of agricultural aircraft, such as the Piper Pawnee, the Snow fixed-wing aeroplanes, the Kolibrie helicopter and the Benson and Umbaugh autogyros, were discussed.

Recent work on spraying—efficient droplet size, the biological effects of sprays and the danger of spray drift—has demonstrated that for agricultural spraying droplet size of a Sauter mean diameter of approximately 200μ is effective; that redistribution of the spray deposit through dew, rain on the leaves or systemic action in the plant is necessary for most pesticides; that elastic spray droplets, rearward discharge of the spray nozzles and very low flying are adequate to prevent most drift problems, except, of course, in windy conditions.

Ram air distributors are adequate for fertiliser spreading or seeding by aeroplane, but for rotary-wing aircraft a new spinning disk distributor constitutes the best fertiliser spreader proposed to date. While electrostatic precipitation of the spray droplet is unnecessary for most spray application in this country, an electrostatic precipitation of pesticide dusts has shown great advances for aerial dusting.

A better utilisation of the aircraft employed in agricultural aviation can now be obtained by extending the spraying season by means of a series of fertiliser and pesticide applications. On potatoes, blight prevention can be complemented by aerial haulm killing with a new desiccant called 'Diquat'. Pasture renovation on low land or on hills can be achieved by the control of unpalatable and unthrifty grasses with dalapon—'chemical ploughing'; the control of perennial weed grasses by the aerial spraying of stubble in wet autumns is now possible with dalapon and dressings with nitrogenous fertilisers and lime.

The addition of fluorescent substances to pesticides provides a convenient method of inspecting the spray deposits on the crop by a daylight viewing chamber or in the ultra-violet light of a Wood's lamp at night, and thus constitutes an important way of improving the accuracy of aerial spraying.

Agricultural aviation is an important modern tool to enable the farmer and horticulturist to adapt his operation speedily to variations in climate from year to year and to carry out operations on time despite adverse conditions which would preclude the use of tractor - drawn distributors and sprayers.

Gross acreage treated by agricultural aviation

(Compiled from various sources)

Country	*Year*	*Acreage treated*
U.S.A.	1958	86,000,000
U.S.S.R. ..	1959	48,000,000
China	1959	2,700,000
New Zealand ..	1959	2,200,000
Australia ..	1958	2,115,000
U.K.	1959	250,000
Netherlands ..	1959	130,000
World total (estimated)		150,000,000

New Publications

Grassland Sward

Better Grassland Sward by A. Voisin. Pp. 340. Crosby, Lockwood & Son Ltd., London, 1960. Price 42*s*.

This is the third book by M. Voisin which deals with the management and productivity of grassland. In this book he is particularly concerned with the ecological factors which influence the botanical composition and productivity of swards. M. Voisin emphasises that the ecology of grassland is essentially dynamic and continually changing according to the managements which are imposed.

The author describes the effect of frequency and height of cutting on the botanical composition of grass swards and points out the differences which can be achieved by using either the animal or a cutting machine for defoliation. Evidence is produced to show that swards which are normally cut for hay etc. can be greatly improved by an occasional grazing.

Conversely, it should be noted that a cut for silage on swards normally grazed, removes any mature herbage which has been left by stock and results in subsequent better utilisation. The importance of management in determining the botanical composition of new swards is stressed and it is pointed out that the amount of seed sown is relatively unimportant in determining the subsequent botanical composition.

A whole section is devoted to the so-called 'years of depression' which the author considers follow the establishment of new swards. This is the period during the early years of a sward's life when production is stated to decline below the initial high yield of the first harvest year. After several years, production begins to improve and eventually the sward is stabilised as a permanent pasture with high production. The relative values of leys and permanent pasture are, however, very difficult to compare without having a great deal of information as to the actual quality of the permanent pasture and leys involved.

Using the author's own argument concerning the all-important factor of management, it should be possible to manage newly-sown swards so that production is maintained at a high level without entering the year of depression. Examples are quoted where leys used in alternate systems of husbandry become increasingly difficult to establish and eventually produce poor crops of grass. It should be remembered, however, that in many cases these leys form part of an intensive farming system, in which the arable crops are exhaustive. Therefore it is hardly surprising that after several rotations the grass itself is affected by the reduced fertility of the soil and an appreciable period under sward conditions may be necessary before soil conditions are improved.

The effect of the following factors on the botanical composition of swards are also considered: treading and 'poaching' by animals; return of dung and urine; light; soil moisture; soil acidity; phosphate; potash and trace elements.

A whole section is devoted to the effects of nitrogenous fertilisers. The importance of correcting the basic fertiliser levels before using nitrogen is stressed, while it is pointed out that both nitrogen fertiliser and clover in excess can have deleterious effects on animals. It is suggested that probably a balance between the two is the correct answer, with not more than 20 to 25% white clover. The final sections deal with the influence of harrowing and rolling on sward production and also the value of earthworms in providing better grassland swards. The book is attractively presented, is very easy to read and it includes an extensive bibliography.

H. K. BAKER

Tea Research

Annual Report for 1959, Tea Research Institute of East Africa, P.O. Box 91, Kericho, Kenya. Pp. 40.

This report deals mainly with the work in progress at the original Tea Research Station at Kericho. These include the study and development of the tea bush under various systems of pruning and plucking, from which it is concluded that a certain balance of such processes is necessary to produce the best bush. No heights and measurements are given and the reader is merely left with a general statement on something already known to planters.

In the chemical branch the study of the effect of sulphate of ammonia on soil acidity and soil bases continues, but nowhere in the report is there any mention of experiments in tea manufacture, although in recent years there has been much work done in East African factories in the trial of rotating withering drums. These drums are filled with leaf which is subjected to a warm air current during rotation.

Scientific study over many years has closely defined the conditions for ideal withering, including rate of drying, length and degree of wither, correct temperatures and so on. It has come to be realised that during withering the leaf must not be handled or moved about. To work economically the withering drum must disobey all these rules, so failure was inevitable from the start. Yet many drums were installed, countless experiments have been made and much money wasted. If the Institute had carried out a few authoritative tests much time and expense could have been saved.

The formal opening of the new Research Station at Timbili took place in March 1959 and experiments with tea grown under leguminous shade trees were started in 1960.

C. R. HARLER

Jamaican Soil Survey

Jamaica; Soil and Land-Use Surveys. No. 10—Parish of St. Mary. By K. C. Vernon. Imperial College of Tropical Agriculture, Trinidad, West Indies. Pp. 30, soil maps. 1960. Price 14*s*.

This report is one of the results of a series of soil surveys under the British West Indies Soil Research Scheme, administered by the Imperial College of Tropical Agriculture. The broad aims of the scheme are to carry out systematic soil surveys, together with related research into the chemistry and physics of the main soil types, including an investigation of the possible role of trace elements in West Indian agriculture and the interpretation of results in terms of land usage and land capacity. The present report concerns one of the 13 parishes of Jamaica; similar reports have been published

covering six others. It is hoped that the soil survey of the island, when completed, will be written up and published as a whole.

One observes that the present report deals with factors affecting land use, a description of the soils and their capabilities and recommendations. Appendices give the important characteristics of the soils, acreages and soil profile descriptions. Information on the chemistry and physics of these soils and the possible role of trace elements is not included—presumably these matters will be dealt with in a separate report or be made available for inclusion in the completed survey for the island.

The author is sensitive to possible criticism from purists who may feel that the basic detail of soil characters should not be relegated to an appendix. He has, however, been well advised to endeavour to write a report which is readable and interesting to those primarily responsible for application of the studies. Detailed surveys such as this are, no doubt, costly; they demand much hard work and concentration from those who carry out the surveys, but they are of great and permanent value. West Indian agriculture should profit by this report if due regard is paid to its recommendations.

D. H. GRIST

Plant Protection

Protectia Plantelor by A. Savulescu *et al.* Publ. by Editura Academiei Republicii Populare Romine, Bucharest, 1960. Pp. 416. Illus. In Rumanian, with Russian and French summaries. Price 18.5 Lei.

This book has been published as an aid in land use planning and in the division of Rumania into agricultural crop production zones. It is a complete synthesis of information on the pests and diseases and the methods of protection of plants of economic importance in Rumania.

Ten groups of plants are covered: cereals, industrial plants, such as potatoes and sugar-beet, vegetables, vines, orchard fruits, ornamental plants, forage plants, medicinal plants, conifers and broad-leaved trees. For the principal plants within each group information is given on parasitic and non-parasitic diseases, harmful insects and control measures. Chapters are also given on harmful birds and harmful rodents in Rumania and means of controlling them.

The book throws much light on the state of agriculture in general and plant protection in particular, in a little-known corner of Europe. The language barrier is unfortunate, but the 15-page French summary covers many of the salient points.

W. LINNARD

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Rhinoceros Beetles

Diseases and Biological Control in Rhinoceros Beetles by P. Surany. South Pacific Commission Technical Paper No. 128, March 1960. Pp. 62. Obtainable from the South Pacific Commission, Noumea, New Caledonia. Price 6*s*.

All evidence obtained by the author from the study of diseases in *Oryctes* seems to suggest that the biological control of the rhinoceros beetle is accomplished by two dominant diseases caused by organisms of a viral nature.

The author first gives an account of the life history of the rhinoceros beetle, its predators, its parasites and the diseases affecting it. He then discusses physical, chemical and biological methods of control of this pest and finally concentrates on a study of the diseases and the effect of these diseases on *Oryctes* populations.

F. C. COOKE

FAO Publications

Multilingual Vocabulary of Soil Science. Edited by G. V. Jacks, R. Tavernier and D. H. Boalch. Second edition (revised) 1960. Pp. 430. Price $4.50 or 22*s*. 6*d*.

Trade Yearbook, 1959, Vol. 13. In Eng., Fr. and Sp. Pp. 349. Price $3.50 or 17*s*. 6*d*.

World Grain Trade Statistics, 1959-60. In Eng., Fr. and Sp. Pp. 62. Price $0.50 or 2*s*. 6*d*.

Yearbook of Forest Product Statistics, 1960. In Eng., Fr. and Sp. Pp. 160. Price $2.50 or 12*s*. 6*d*.

The above publications are available from H.M.S.O., P.O. Box 569, *London, S.E.*1, *or local sales agents.*

U.S.D.A. Publications

World Survey of Agricultural Machinery and Equipment. Five pamphlets covering Asia, South America, Africa and Australia-Oceania, Europe, and North America (the latter not yet available). Price 15 cents each.

Potato Blight Epidemics Throughout the World. U.S.D.A. Agriculture Handbook No. 174 by A. E. Cox and E. C. Large. Unpriced publication. Single copies can be obtained on application.

All above publications available from the Superintendent of Documents, Government Printing Office, Washington 25, *D.C., U.S.A.*

Bulletins and Reports

Organisation for European Economic Co-operation. Published by the European Productivity Agency. 'The Consumption of Fruit and Vegetables in O.E.E.C. Countries'. Project No. 372/2. Pp. 220. Price $2 or 12*s*. 6*d*. from H.M. Stationery Office, P.O. Box 569, London, S.E.1.

Empire Cotton Growing Corporation. Progress Reports from Experiment Stations, Season 1959-60—'Kenya' and 'Aden Protectorate'. Price 2*s*. 6*d*. each report, post free, from the Empire Cotton Growing Corporation, 12 Chantry House, Eccleston Street, London, S.W.1.

*Ministry of Agriculture and Lands, Jamaica, W.*1. Bulletin No. 57, 'Investigations 1956-57'. Pp. 140. Price 3*s*. 6*d*. from the Government Printer, Duke Street, Kingston, Jamaica, West Indies.

Spraying Machinery and Equipment

Aerial Applications

Big contractors are able to keep two aeroplanes—one for dry material jobs only and the other for spraying operations. Where only one machine is kept, it is a half-day's work to remove a liquid boom system and replace it with a dust spreader before dry materials can be applied. It is therefore economical, either in machines or in time, to use an aerial applicator which can dispense either dry or liquid materials or granules, pellets or seed, according to requirements, without any loss of time, merely by resetting the pilot control of the distributor unit.

The '*Swathmaster*' distributor unit consists of a hopper, a propeller-operated agitator, micrometer-adjusted gate control and two perforated wings through which the dust, seed or liquids are distributed into the air stream, so producing a 33-ft. swath. At 90 m.p.h. an air intake of 110 cu. ft. per sec. provides the dispersing force. A wind-driven propeller and a reduction gear turn the agitator in the base of the hopper to ensure an even flow of dry materials and to keep liquids and suspensions in continuous circulation during spraying operations.

The micrometer is easily adjustable, either on the ground or in flight, to the required rate of dust or spray application. The gate and control linkages are mounted on bearings to give finger-tip control and a sharp cut-off when the pilot closes the gate. In emergencies a full load can be dumped from the hopper in from 3-5 sec.

Spray Cleaning

The *Opancol* 'Kleen Gun' is a cleaning device which is operated by the exhaust gases from a tractor or lorry engine.

Using a cleaning and degreasing compound mixed with water, it produces a high-pressure jet of cleaning vapour which will remove grease and caked mud from tractor wheels and farm implements, leaving the surfaces ready for painting, lubrication or overhaul.

Spraying a lemon grove in California with a granular dust containing 5% chlordane at 50 lb. per acre for the control of ants. The distribution wings can be seen below the plane

Power Spraying

What is claimed by its makers to be the most powerful tractor-mounted mist sprayer ever produced was recently seen in action by our representative in an apple orchard in Kent, England. The new '*Powermist Major*' was demonstrated both on the *Fordson* 'Power Major' and on a *Massey-Ferguson* '35'; on the former the powerful fan produces 35,000 cu. ft. per min. of air, moving at 110 m.p.h., and on the lower-powered tractor about 30,000 cu. ft., moving at 95 m.p.h.

Such high-volume, high-speed application will naturally ensure the effective displacement of the air in the foliage of the trees and thorough wetting and penetration by the spray chemical. The effective radius, with the tractor moving at from 1½-3 m.p.h., was 40 ft., so that the machine should be suitable, not only for fruit orchards and vineyards, but also for spraying young plantations of coconuts, oil palms, rubber and other tropical tree crops.

A unique feature in design is its unit construction. Its twin-cylinder pump is directly mounted on the gearbox and no working parts are exposed; there are no chain drives and no 'V' belts; and dust cannot get into the oilbath. Another big achievement is quiet running, which is obtained through this design, while the integrated gearbox, fan casing and frame naturally give strength.

Band Sprayers for Sugar-Beet

The *Dorman* band sprayer for sugar-beet was shown for the first time at the Royal Show and again at the Smithfield Show at the end of the year, and on both occasions it aroused considerable interest amongst sugar-beet growers. It is designed primarily for the economical application of endothal-propham mixtures and for operation with the *Stanhay* or the *Webb* five-row precision seed drill. It is reported that, using specially designed nozzles, a weed-free strip is produced which persists for 6-8 weeks after drilling, while the beet seedlings are developing.

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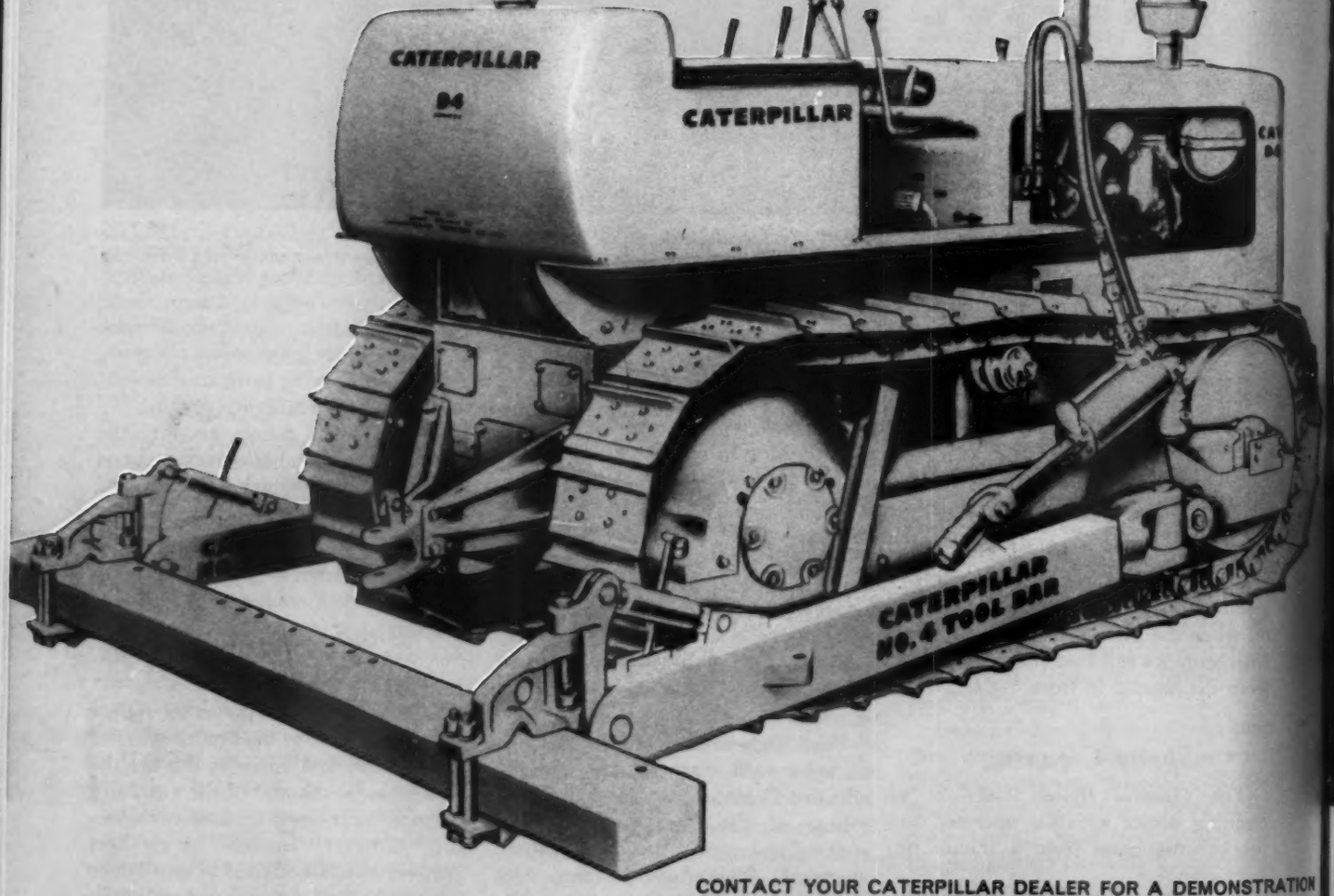

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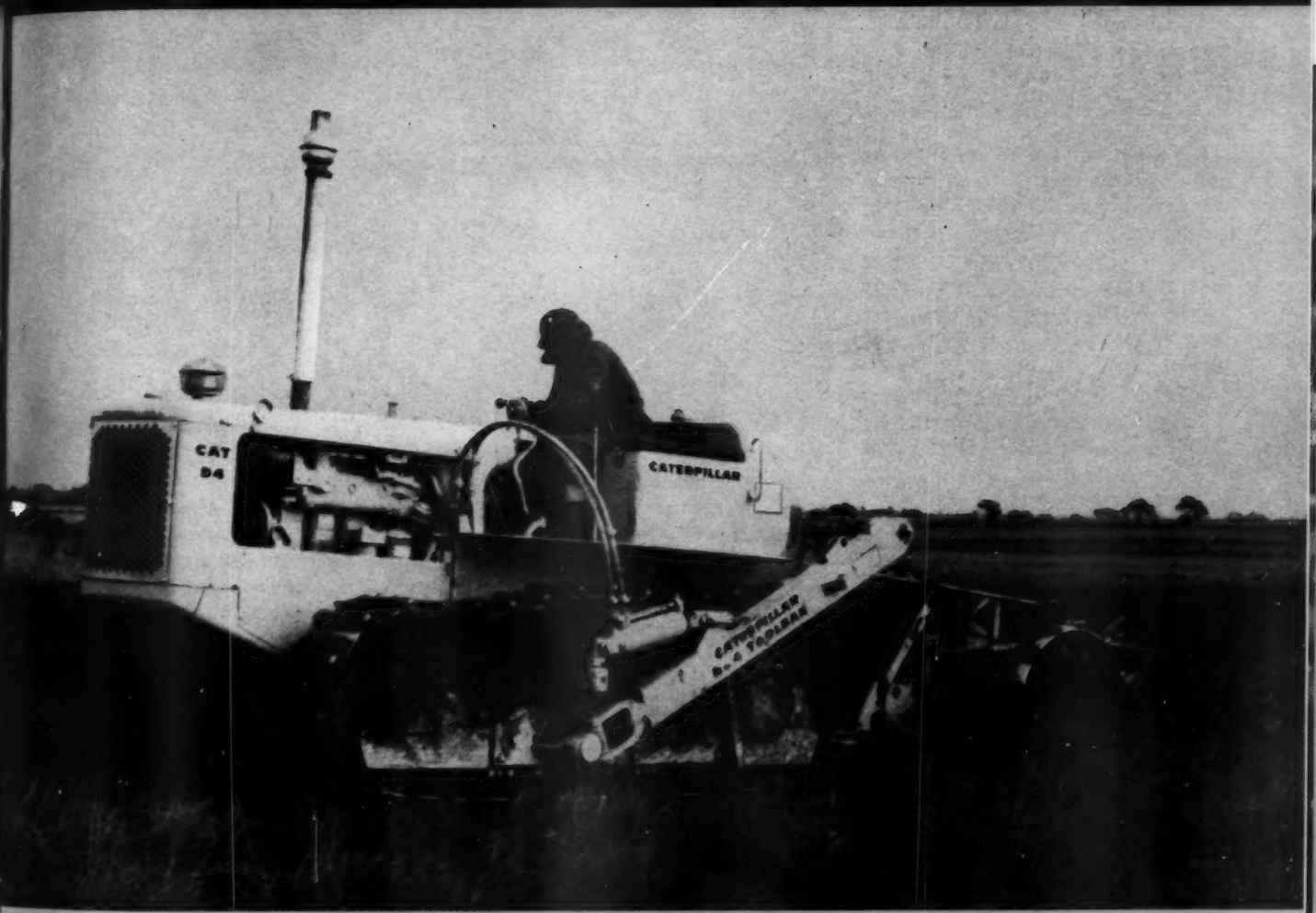

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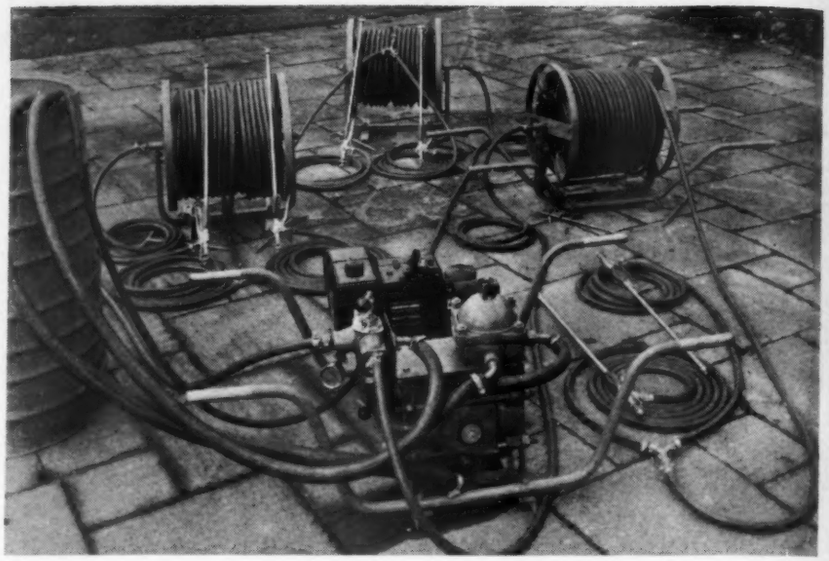
Spraying Group

Young tropical tree crops, such as coconuts, coffee, cocoa, rubber and fruits, are particularly liable to attack by fungus diseases and low-flying insects, and the same, of course, applies to low-growing plantation crops—tea, sugar, pineapples or bananas—which are grown in rows or spaced at regular planting distances. When an outbreak occurs, such as an attack by coconut scale in a young plantation, spraying by gangs of men, area by area, will quickly bring an outbreak under control.

Cooper, Pegler & Co. Ltd. offer for this purpose their new 'TGD' group spraying unit. The power unit consists of a petrol-driven, high-pressure, two-diaphragm pump, which will deliver 9 gal. of spray per min. at a pressure of 425 lb./sq. in. This portable power unit can be carried from point to point over the most difficult terrain, up steep hillsides or over jungle litter, or, if the going is easier, it can be fitted with wheels or carried on a tractor to the affected area. Here a gang of men armed with lances—from three to 12 in number—can quickly cover the foliage of all the affected plants in a considerable area, for up to 1,000 ft. of hose may be attached to each pair of spraying lances.



The new 'TGD' portable gang sprayer as fitted with three reels of hose and with two spraying lances attached to each reel

Granular Applications

This method of applying fertilisers, insecticides, nematocides and fungicides has, in some circumstances, certain advantages over the older methods of distributing these agricultural chemicals.

Thus, when granular chemicals are applied close to the ground, there is little, if any, danger from ' drift', even in high winds; secondly, band applications can be applied more exactly to row crops, thus saving valuable materials; thirdly, it is possible to do two operations at the same time—to apply a pre-emergent weedkiller when seeding or a systemic insecticide during inter - row hoeing; and, fourthly, granules are much less bulky than the same amount of agricultural chemicals in solution, no mixing is required and water does not need to be carried to the scene of operations. In the case of fertilisers, the granules do not adhere to the leaves, but are slowly broken down on the soil around each plant.

The *Noble* granular applicator can apply both insecticides and herbicides, or herbicides and granular fertilisers at the same time as the operations of seeding and inter-row cultivations by mounting one of these units on the implement—seeding machine or hoe. An obvious application would, for instance, be the top dressing of sugar-beet.

Its dual hopper will hold 16 lb. of insecticide and 32 lb. of herbicide and a precision metering device with an instantaneous cut-off prevents excess and wastage when turning at the headlands. There is a 14-in. spreader at the end of each flexible delivery tube, and so the spreader can hug the ground and prevent 'drift'. The spreading rate is adjustable from 8 oz.-50 lb. per acre.

Noble applicators mounted on the implement bar of a four-row seeding machine

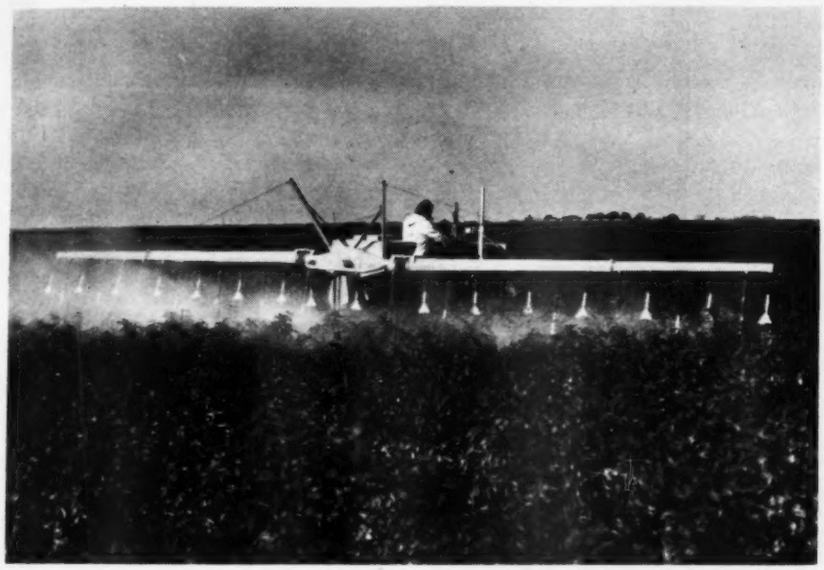
To Reduce Spray Drift

Spraying Systems Co., of U.S.A., have introduced a new type of wide-angle spray nozzle tip. These 'TK FloodJet' tips produce a flat 120°-angled spray that is projected at an angle of 75° to the spray nozzle axis and this allows a close-to-ground mounting of the spray boom. This low-level spraying naturally reduces spray drift and the wide-angle spraying gives wider coverage, so that fewer nozzles are needed on each boom. The tips are available, both in brass and stainless steel, for use with brass, stainless steel or nylon 'TeeJet' nozzle assemblies.

Dusting Row Crops

The '*Dustmaster*' is a precision dusting machine for mounting on the three-point linkage of a tractor. A high-speed shaft, driven by the p.t.-o., actuates the powder feed worm through a reduction gear. The multi-blade blower, operated through triple 'V' belts, delivers the powder along the booms and into and under the foliage through 31 down pipes, which are fitted alternately with fishtails and open ends, delivering at a lower level to ensure even coverage. These down pipes are easily removable, or they can be adjusted for height to suit the crop under treatment. The overall boom width of the 30-row machine is 36 ft.; the booms can be folded up by the driver without leaving his seat, and the whole machine can be detached and left standing on its own legs.

Application rates may be varied from 1-6 gal. per acre and the tank capacity is 20 gal.



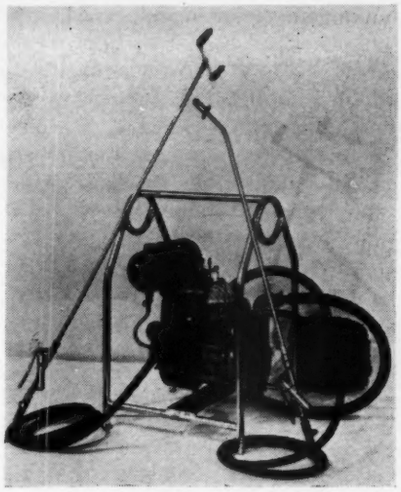
*A 30-row '*Dustmaster*' being used to control potato blight*

Spraying Fruit Crops

The 'Mantis', the latest addition to the *Micron* range of concentrate sprayers, is designed primarily for spraying black currants, hops and cordon fruit. The unit is attached to the three-point linkage and is driven from the tractor p.t.-o. through a *Hardy Spicer* self-adjusting shaft. The 18-in. fan is belt-driven and the atomiser, mounted in front of it, revolves at about 6,000 r.p.m., delivering 8,000 cu. ft. of air per min.

This rotary sprayer provides excellent atomisation—the uniformly fine spray so essential for concentrate spraying with chemicals which would otherwise be phytotoxic. This, according to the makers, makes it possible for growers to continue spraying right through the season with materials as phytotoxic as lime sulphur. They claim that it gives excellent coverage without wastage or scorch.

The machine is indeed remarkably compact and light and, fitting snugly at the rear of the tractor, gives good balance and a small turning circle.



This Evers & Wall portable spraying unit, powered by a four-stroke petrol engine, is capable of an output of up to 300 gal. per hour. It is particularly suitable for operation in confined spaces, such as in plant houses

Spraying in Comfort

The comfort of the operator is of supreme importance when crops on steep hillsides (*e.g.* 1 in 1) or in a rocky terrain have to be treated. The *Allman* 'Mistblower' we have found to be a particularly snug knapsack unit, which an operator can use in difficult conditions in the tropics without undue fatigue. With full fuel and spray tanks it weighs 50 lb., and unladen 26 lb.

It is powered by a tiny, yet reliable, 26-c.c., two-stroke engine which develops 0.85 h.p., with an aluminium

The 'Mantis' about to begin spraying black currants for the control of gall mite

fan directly mounted on its crankshaft. This fan produces an air-blast which carries the spray 23 ft. horizontally or 20 ft. vertically and the size of the droplets is 10-100μ.

The machine can be converted into a dusting unit simply by changing the spray tank and fitting a dust container which holds 4 lb. of dust. The throw for dust is 20 ft. vertically and 23 ft. horizontally.

Automatic Dilution

The '*LiquiSprayer*' is an interesting new device for applying weedkillers, tree washes, liquid manures, insecticides and trace elements in liquid form to small horticultural and experimental plots without the time-consuming labour of carrying heavy buckets. The unit is simply attached to the end of an ordinary garden hose after the required amount of liquid manure or chemical has been put into the container and some water has been added. When the water supply is turned on, the contents are automatically diluted, up to 15 gal. of spray being applied at each filling. There is a choice of three separate nozzles and these can be adjusted to produce either a fan-shaped spray or a single jet.

Irrigation Without Guesswork

According to *Almond Facts*, journal of the Californian almond industry of the U.S.A., it is sound practice to maintain a continuous record of soil moisture conditions in the root zones of almond trees. The soil moisture tensiometer is an instrument which is used for indicating when to irrigate and also for detecting drainage problems. A number of tensiometer stations are established, the instruments being placed at 2, 4, 6, 8 and 10 ft. at each station; the readings not only indicate when to irrigate, but also how long irrigation needs to go on in order to establish optimum moisture throughout the entire root zone of the tree.

One of the instruments which can be used for this type of control is the 'Irrometer'. It consists of a sealed water-filled tube with a porous tip and a vacuum gauge. In a dry soil, water is drawn out of the instrument, so creating a partial vacuum, which is indicated on the gauge—the drier the soil, obviously the higher the reading. Following irrigation there is a lower gauge reading. The instrument thus indicates the availability of water held by the soil irrespective of the soil type.

The manufacturers, *T. W. Prosser Co.*, claim that both the yield and the quality of a crop can be improved by applying the right amount of water at the right time and in the right way. Their system, they say, saves water and indicates when the soil conditions are such that water should be withheld.

The 'Span Flow' system consists of a supplementary wing, carried beneath the aircraft, on to which dust or granular materials are metered. Aerodynamic forces on this wing spread the material uniformly across its span. This system of aerial dusting is being produced by the Agricultural Aviation Eng. Co. of U.S.A.

The Wolseley neon flasher with its ground spike for earthing

Pest Scarers

Shock tactics, which are so effective in keeping stock inside an enclosure, can also be used with success to keep out most kinds of wild animals, such as wild pig, baboon and similar pests of tropical crops, where the cost of fencing would be prohibitive. *Wolseley Engineering Ltd.* are manufacturers of electric fencing units and accessories, one of which is a neon flashing light for scaring foxes and other wild life.

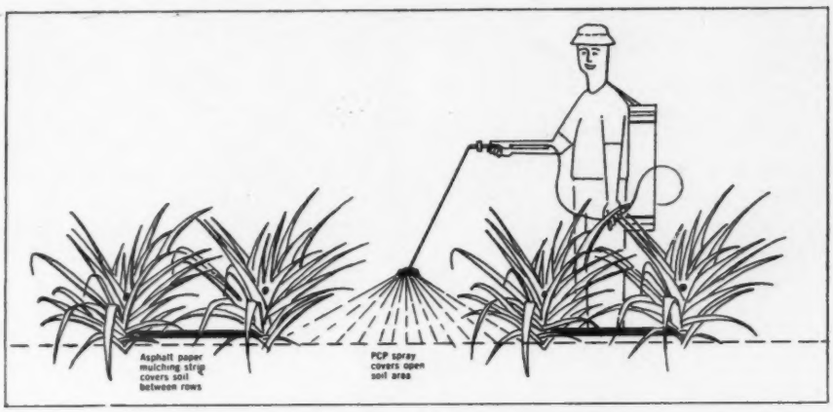
This light can be hooked to the fencing line at any point. It can be seen from a considerable distance and is not only useful for keeping foxes away from lambing pens and poultry houses, but also for providing a check that the electric fence is operating and that there is no break or short in the line.

One Wolseley fencer will operate six flashers and still give a good shock on the line to warn off other marauders. If more flashers are used, there will naturally be a lowering of the shocking power.

Agricultural Chemicals

Weed Control in Certain Plantation Crops

Labour for weeding and slashing is increasingly costly. The careless use of a machete or parang, too, has led to fungus disease being introduced into the injured bark of coffee and cacao trees. Coconuts also can be badly infected by such wounding. Bananas are subject to bacterial wilt (Mojo disease) and Fusarium wilt (Panama disease), both of which are transported with great ease on the blade of the machete from a diseased plant to the next in a row. Such problems can be overcome by chemical weed control.



Method of spraying under the foliage of pineapple plants

Chemical weed control

Not all weedkillers are equally safe for use on plantation crops, however. With the powerful systemic weedkillers, such as 2,4-D, for instance, care must be taken to avoid drift, even in minute amounts, from the weed spray area to nearby susceptible crops. It is indeed difficult to use 2,4-D for the weeding of coffee, cacao and bananas without incurring crop injury. This has led to wider use of safer non-systemic chemicals.

The safest materials for spraying are oils, which can be applied selectively to the weeds, avoiding the crops. Usually oils alone are not sufficiently toxic to the weeds, but they can be made much more effective by the addition of a chemical poisonous to the leaves. One chemical used is a special formulation of pentachlorophenol, the safety of which is due to its non-systemic action. It burns the leaves of the weeds upon contact, but does not drift away from the point of application in toxic quantities. The spray is applied to the weeds without spraying the leaves of the crop.

PCP is a contact weedkiller which is primarily used against the grass-type weeds. If the weeds are tall, they should be cut down with a machete or rotary slasher in order to initiate chemical control. Spraying should begin when the regrowth of weeds is 3-4 in. in height. The best time to spray with PCP is on a hot, dry day, and not when the plants are wet with rain or dew.

Treatment of individual crops

Sugar-cane.—Hand spraying to clean out noxious grasses should be undertaken when the cane reaches 3-5 ft. in height. To avoid striking the leaves of the cane the spray lance is directed at the low-growing grass on the ground and not at the crop.

Bananas.—It is necessary to wait until the plants or suckers are at least 1 ft. high before spraying. Usually three or four sprays per year will be sufficient.

Coffee.—The amount of weeds in coffee depends upon the shade, density of planting and the weather. Usually three to five treatments per year will control the weeds, even in areas of heavy rainfall. Mulching combines well with PCP spraying and reduces the amount of spray needed for weed control.

Reader Service

For further information on any item reviewed in this issue please use the card provided or write to:

Reader Service,

WORLD CROPS,

Leonard Hill House,

Eden Street, London, N.W.1

England

Pineapples.—The spray must be directed at the weeds and away from the crop. At the time of planting, a double row of pineapple plants is set with 2-ft. spacing between rows by planting the slips through a bitumenised paper strip. This use of paper around the plants does away with the necessity of spraying both sides of the row. The PCP spray is applied in the 4-ft. wide uncovered lane. This one-sided spraying reduces the injury to the crop by the weedkiller.

Cocoa.—PCP is a safe weedkiller for use around cocoa trees because it is not systemic in action. This material, used as described above, has controlled weed growth for 80 days if applied during the early part of the rainy season. Frequently weeds grow most luxuriantly during the first three or four weeks of the rainy season and are most susceptible to control during that time. A dry day must, however, be chosen for spraying to ensure maximum 'scorch' of the weeds.

Coconuts.—Because of the abundant sunlight which reaches the ground in a young coconut plantation there is frequently a heavy grass weed cover under the palms. To control this with PCP it is necessary to begin by mowing or slashing the weeds down to the ground and to begin spraying when the fresh growth is 4 in. high.

This is an abridged version of the Olin Mathieson Agricultural Bulletin, No. 49

Liquid Manures

Liquinure liquid manures are available in three forms for small plot manuring:

	Analysis		
Mixture	$N\%$	$P_2O_5\%$	$K_2O\%$
General..	9.0	6.6	4.1
Tomatoes	5.7	6.6	7.4
Flowers..	12.0	7.2	4.0

The manufacturers state that these mixtures contain the essential plant nutrients, including trace elements, in the required proportions. They are naturally easy to apply—either by direct dilution in a 2-gal. watering can or by automatic dilution in a 'LiquiSprayer' fitted to the end of a water hose.

Export Drive Planned

Fisons has long recognised the importance of a strong export trade, and in recent years export sales have been built up by Fisons Chemicals (Export) Ltd. This company has now been reorganised and the name changed to *Fisons Overseas Ltd.*, which will in future control the whole of the overseas activities of all companies in the chemical division of Fisons. Already the overseas sales of these companies account for nearly 40% of the total chemical division sales, and one of the chief aims of the reorganisation will be to increase exports to an even higher level, particularly in South America and the U.S.A. It will also be responsible for the licensing of products of the group for overseas manufacture.

The products manufactured by this company include fertilisers, agricultural chemicals, pharmaceuticals, industrial chemicals, food products and laboratory glassware.

Insect Control

Fumite lindane is recommended for the control of litter mites, *Tyroglyphid* sp., and other insects in poultry houses. It is supplied in the form of a pyrotechnic mixture in aluminium canisters. When ignited it generates a penetrating smoke of benzene hexachloride, which is evenly distributed over the litter in all parts of the house. Naturally, the house must be empty of stock during the treatment.

Pests of Cotton

Chemicals Used for Control by Aircraft

These chemicals are listed in the order of preference as determined by the technical staff of the International Agricultural Aviation Centre, based on findings in the U.S.A., Africa and the Middle East. In most cases the chemical with the strongest action is mentioned first, but in some cases the actual differences may be very slight.

Differences in operational conditions (such as risks for man and livestock) may induce operators to adopt a somewhat different order of preference.

About 60% of the total area of 15 million acres under cotton in the U.S.A. is treated by aircraft. Statistics for the other countries named are either unreliable or not available.

Pest	*Chemical*	*Countries*
Cutworm and certain army worms	Toxaphene or DDT	U.S.A.
Thrips, fleahoppers, jassids, overwintered bollweevils	Endrin, sevin, toxaphene, heptachlor, aldrin or dieldrin	U.S.A., Sudan, Congo
Aphids, white fly	Methyl parathion, sevin, parathion, malathion, demeton or endrin	U.S.A., Tanganyika, Sudan, Brazil
Bollworms and bollweevils	Endrin, sevin, toxaphene, heptachlor + DDT (mixture), or aldrin + DDT	U.S.A., Afghanistan, Iraq, Iran, Sudan, Congo, S. Rhodesia, India
Pink bollworms	Sevin, endrin, DDT, or guthion + DDT	U.S.A.
Spider mites	Methyl parathion, parathion, demeton, sulphur or aramite	U.S.A., Iraq, Iran
Lygus and stink bugs	Sevin, toxaphene + DDT, or BHC + DDT	U.S.A.
Leafworms	Methyl parathion, parathion, toxaphene + DDT, or malathion	U.S.A.
Grasshoppers	Toxaphene, heptachlor or aldrin	U.S.A.

World Crop Reports

INTERNATIONAL REPORTS

Coffee

The 1960-61 world coffee crop is estimated at 64.9 million bags, compared with the record of 78.4 million in 1959-60. The quantity which entered world trade is estimated at 51.3 million, 21% below 1959-60.

North American coffee production for 1960-61 is estimated at 8.6 million bags, with 6.6 million exportable. This is a decline of 10% from the 1959-60 crop.

The 1960-61 crop in *Costa Rica* is, however, expected to establish a new record. Heavy rains and strong winds reduced this year's crop in *El Salvador*. The crops in *Guatemala* and *Mexico* are expected to be lower this year because of unfavourable weather. *Guadeloupe* is expected to have an exportable crop of 10,000 bags, while *Martinique's* crop will fill domestic requirements.

The total 1960-61 coffee crop in *South America* is estimated at 40.1 million bags, of which 30.4 million bags will be exportable. These exports would represent a reduction of 33% below last year's.

The smaller *Brazilian* crop this year is primarily responsible for the big drop in the world production. *Colombia's* crop is only slightly below that of a year ago, while increases are expected for *Ecuador* and *Peru*.

Africa's total 1960-61 crop is estimated at a record 13.1 million bags, with 12.6 million exportable. New plantations coming into production in *Angola* have increased the crop considerably in the past two years. The total 1960-61 coffee crop in the *Ivory Coast* is estimated at 2.5 million bags, with all but 50,000 bags exportable.

The estimated 1960-61 exportable production for some of the smaller producing countries of Africa are: *Dahomey*, 20,000 bags; *Gabon*, 10,000 bags; *Comores Islands*, 2,000 bags; and *Republic of Congo*, 10,000 bags. No production for export is expected this year from the *Reunion Islands*.

Total 1960-61 coffee production for *Asia and Oceania* is estimated at 3 million bags, with 1.8 million exportable. The 1960-61 crop of 375,000 bags in the *Philippines* (all consumed locally) is smaller than in 1959-60, due to strong winds and heavy rains. Exportable production in 1960-61 for some of the smaller producing countries of Asia and Oceania are as follows: *New Caledonia*, 25,000 bags; *New Hebrides*, 4,000 bags; *North Borneo*, 2,000 bags; *Portuguese Timor*, 20,000 bags; *Vietnam*, 20,000 bags; *French Oceania*, 4,000 bags.

Coffee, Coffea arabica *var. Mundo Novo. A plantation near Campinas grown from selected seed by the Instituto Agronomico of Brazil. Brazil is the leading producer of the world's coffee*

Maize

The earlier forecasts of a record 1960 world maize production of 8,100 million bushels have now been confirmed.

The most significant gains were in the U.S.A., where a new record was set, in the U.S.S.R. and in Eastern Europe, with near-record crops, and in South America, where the largest harvest of recent years is expected.

Maize production in *North America* is estimated at 4,622 million bushels. The slight increase over 1959 is entirely due to a record U.S. out-turn, which at 4,353 million bushels is 72 million bushels above the 1959 record. Part of the increase, however, is offset by a smaller crop in Mexico and minor producing countries. *U.S. acreage was 1.4 million acres less than in 1959, but yields were at a record level.*

Maize production in Western Europe is estimated at 330 million bushels. This is a record for the area, mainly because of a sharp rise in *France:* that country is showing great interest in increasing its maize output and the 1960 crop of 103 million bushels contrasts with the 1950-54 average of 26 million. During that period acreage jumped from 894,000 acres to 2 million acres. Yields are also up sharply, the 1960 average of 51 bushels per acre contrasting with 29.5 bushels in 1950-54.

Production has also increased in *Italy*, though not so markedly as in France. The current estimate of 150 million bushels is slightly less than in 1959, but is well above the 1950-54 average of 112 million. France and Italy together produced three-quarters of Western Europe's total in 1960.

The crop in *Eastern Europe* was large, though not as high as the record crop in 1959. Some reduction is reported in each of the Danube Basin countries, the main producing area. Though smaller than the record 1959 harvest, production in both *Yugoslavia* and *Rumania* is reported at a near-record level and these countries both appear to have a surplus for export.

Maize acreage was substantially

increased in 1960 in the *U.S.S.R.* and the harvest of mature grain and the green ears harvested in the immature stage is estimated to be well above the 1959 harvest and only slightly below the record out-turn of 600 million bushels in 1958. This is in line with the Government's programme to expand maize production to provide cattle feed.

The 1960 crop in *Asia* was slightly less than in 1959, but is still well above average. Expanded acreage in most of the largest producing countries accounted for higher levels of production. No significant change in yields is reported.

No significant change from *Africa's* large 1959 maize total is expected this season. Above-average prospects for the crop nearing the harvesting season in Southern Hemisphere countries account for maintenance of this high level.

The outlook is for the largest maize crop of recent years in *South America*. If conditions continue to be favourable through the harvest, the out-turn may be 600 million bushels, compared with 540 a year ago and an average of 450 million during 1950-54. Prospects are good in both *Argentina* and *Brazil*. These countries together produce 80-85% of South America's maize.

Maize is of minor importance in *Oceania* and a 1960 crop of only 8 million bushels is forecast, but this is slightly above the 1959 production of 7 million.

REGIONAL REPORTS

Cuba

Cuban *kenaf* fibre production in 1959 is now estimated at 170,000 lb., compared with about 275,000 in 1958. Only 115 acres were harvested from the 230 acres planted for fibre; 200 acres were harvested in 1958. The forecast for 1960 is about 200,000 lb. of fibre from 130 acres.

The fibre is used mostly to continue experimental work with harvesting, ribboning and defibring machinery, as well as industrial retting, spinning, and weaving processes. However, kenaf thread is becoming increasingly popular locally for tying tomato plants to stakes, for the manufacture of *alpargatas* (slippers with rope-like soles) and for use by Government post offices.

Demand is good for kenaf seed both for Cuban use and export to other countries. An estimated 330 acres were planted for seed in 1960. Because of late planting, a yield of only about 75,000 lb. of seed is expected, and most of it will be planted in Cuba. An estimated 100,000 lb. of seed were harvested in 1959 from about 300 acres.

India

India's first estimate of *rice* acreage in 1960-61 is estimated at 74.4 million acres. This does not include about 10% of the 1960-61 acreage not planted by 1 October.

The 1960-61 first estimate is 760,000 acres larger than the adjusted corresponding estimate of 73.6 million acres in 1959-60, the previous record. For 1958-59 the corresponding adjusted estimate was 72.8 million acres, and for the five-year period ended 1957-58 the average was 66.5 million acres.

Acreage increased in all States except Andhra Pradesh, Gujarat (formerly part of Bombay) and Assam. The estimate for Orissa is the same as that of the year before. The largest gain was in Bihar, where acreage rose 1 million acres.

Except for lack of rain in some areas of Madhya Pradesh, Andhra Pradesh and Gujarat, the crop condition was generally satisfactory.

India's 1961 *flaxseed* crop to be harvested this spring is expected to total about 17.2 million bushels from 4 million acres. This is about 1% above last year's harvest, officially estimated at 17 million bushels from 4 million acres.

Favourable soil moisture conditions at planting time and attractive prices of flaxseed and linseed oil during the current marketing season induced farmers to plant large acreages, as in the preceding two seasons. Crop progress is generally satisfactory.

Burma

Burma's 1960-61 *oilseed* production appears to have declined from a year earlier in spite of the Government's plans for self-sufficiency in edible oils.

Groundnut production, a project to which the Government gives high priority in planning, will probably produce about 265,000 short tons from a harvested area of almost 1.1 million acres, or about a quarter less than the 1959-60 crop of 302,340 tons from 1 million acres. The decline from the previous year is due to adverse weather, diseases, insects and pests. Moreover, the groundnut areas on the uplands are deficient in fertility due to soil erosion.

Sesame or gingelly production is expected to be 64,000 tons from 1 million acres, compared with the 1959-60 crop of 66,200 tons from 40,000 additional acres.

South Africa

The first official estimate of the 1960 South African *wheat* crop is placed at 7.9 million bags, which means that the harvest is expected to be about 269,000 bags smaller than that of last season. The crop for the Cape wheat belt suffered from some unusually dry conditions and was expected to be about 421,000 bags below last year's figures of 5.2 million bags, while the Free State crop, where growing conditions have been favourable this year, is expected to be 149,000 bags higher than last year's output of 2.2 million bags.

England and Wales

Improved weather conditions during February enabled good progress to be made with cultivations and sowing on lighter soils, but work was generally still behindhand. Little or no progress was possible on heavy soils and work was still much behindhand. Good progress was made with sowing on the light soils during the dry spell. Some delayed sowing of winter wheat was achieved. On heavy soils no drilling was possible and spring sowing was well behindhand.

Early sown *wheat* crops looked very well and had made good progress. Later sown crops were making slow progress and required patching due to waterlogging. Early sown crops of *barley* and *oats* were generally satisfactory. Later sown crops made some progress, but were still backward and patchy. *Rye* and *beans* looked well and had made good progress despite the wet soil conditions.

About 94% of the main *potato* crop had been harvested by 1 March. The recent fine weather enabled quite a substantial acreage to be lifted in February, which offset, to some extent, losses through deterioration in clamps. The keeping quality was generally very variable.

Acknowledgment is made to *For. Crops & Mark.* for much of the information contained in the above reports.